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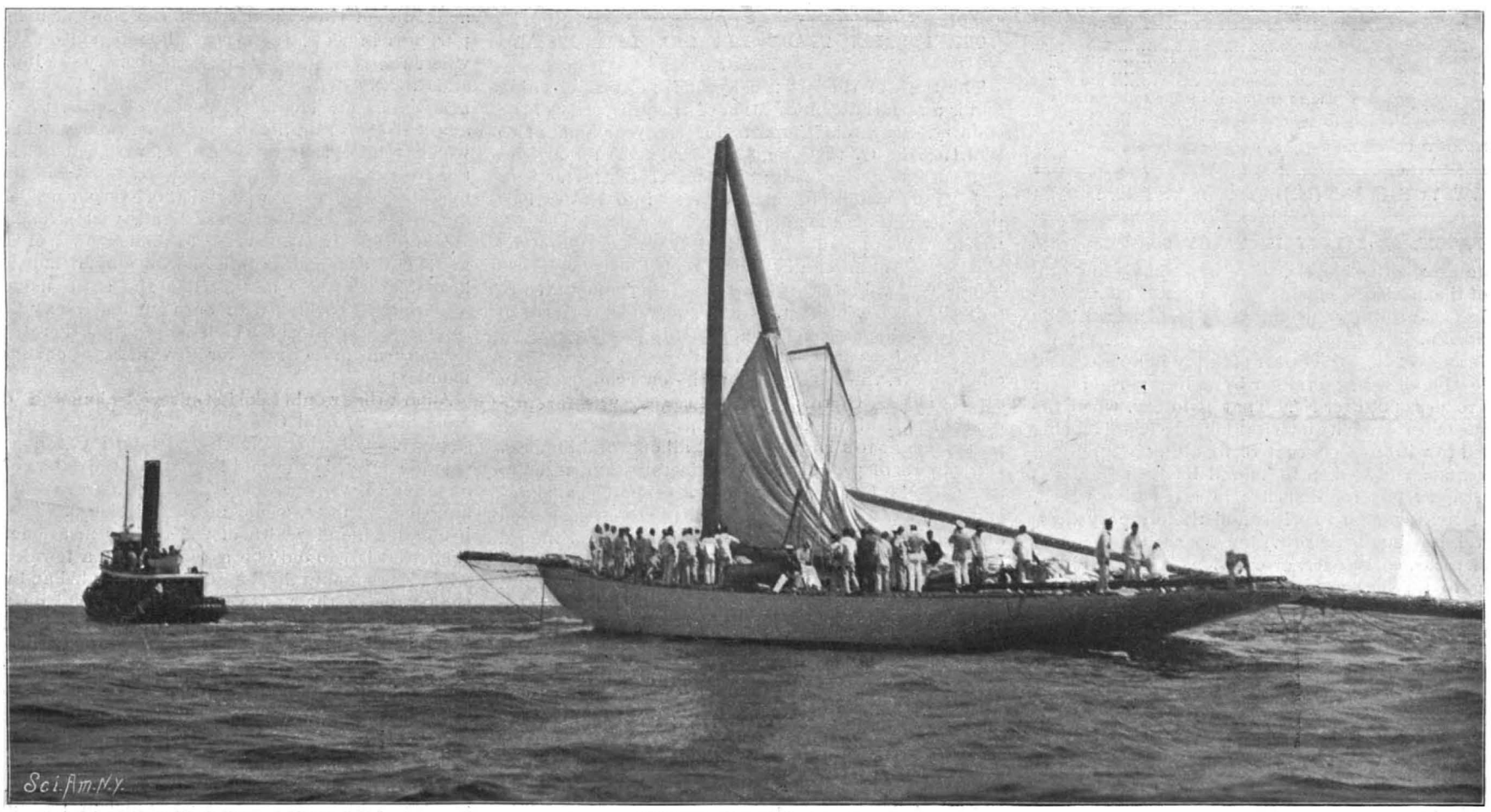

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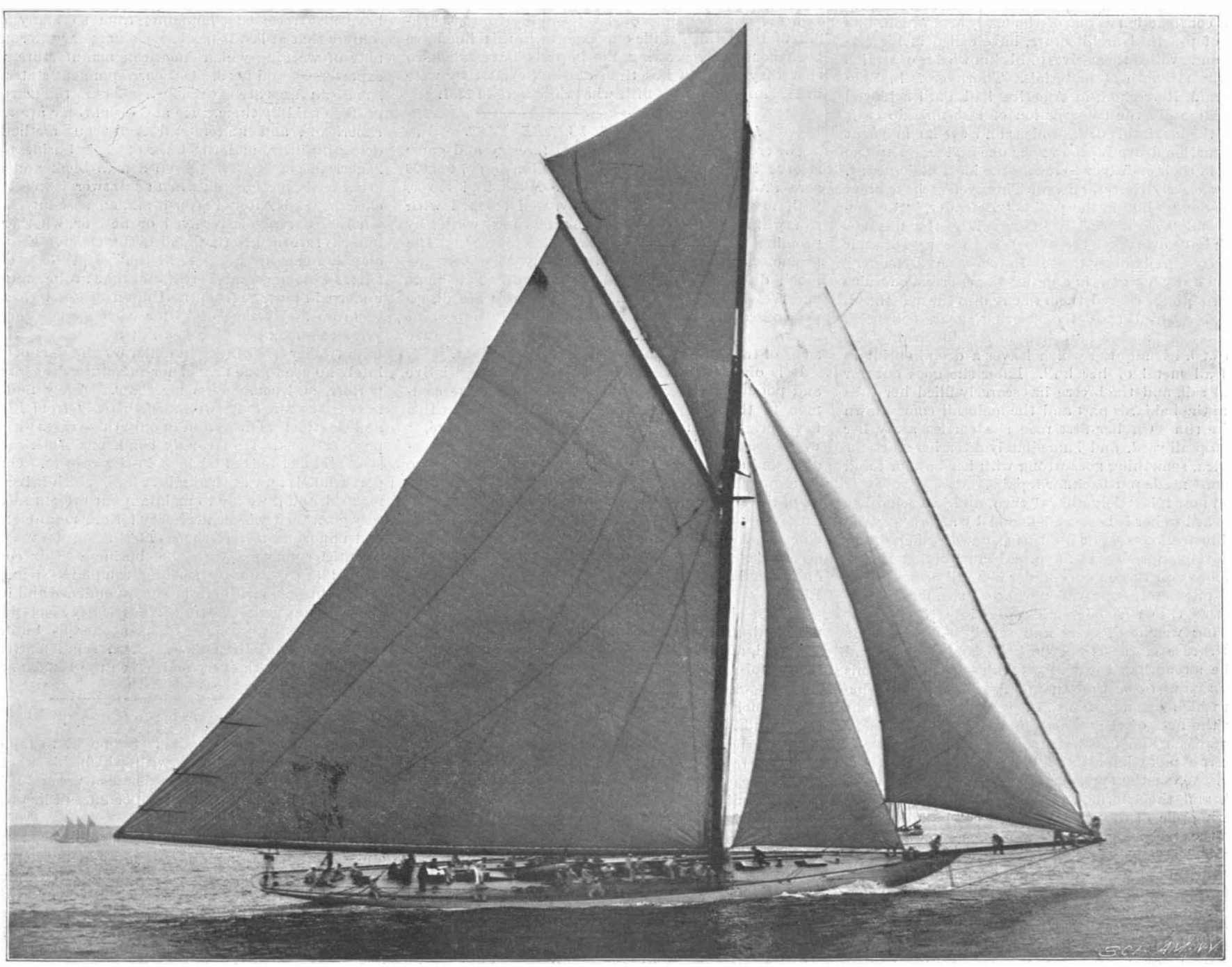

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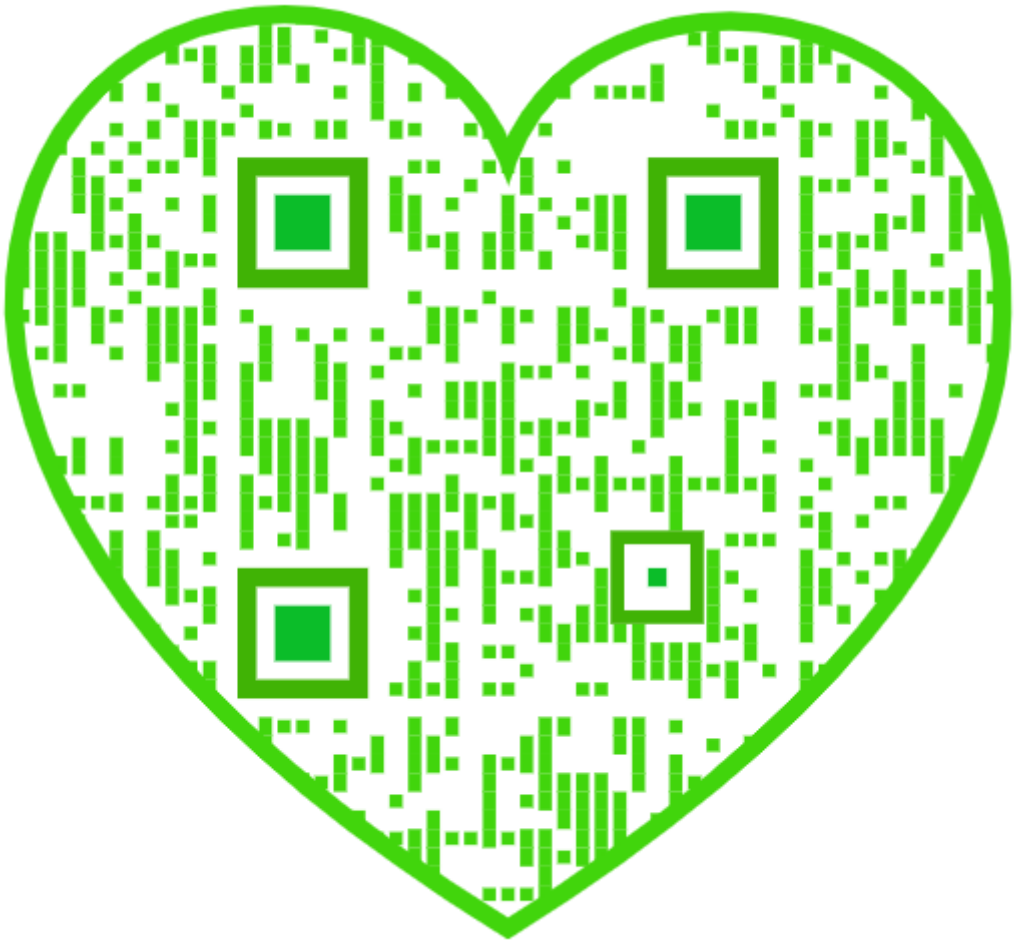

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THE FACTOR OF SAFETY IN YACHT CONSTRUCTION.

If we except the bicycle, there is probably no product of the mechanic in which the factor of safety is reduced so near to the vanishing point as in that highly developed machine known as the racing yacht. It has been estimated that the factor of safety in a light road bicycle when it is being ridden by a heavy rider over rough roads is not over 1⅓. That is to say, when the machine experiences its heaviest jolts the metal is being strained to within 25 per cent of its ultimate strength. The frequency of broken forks and buckled frames is the price we pay for lightness in a machine which, while strong enough to withstand the ordinary stress of travel, has but little provision for accidents in the way of rocks, curbstones, or collisions. The public is willing to sacrifice a surplus of strength in favor of light weight, and in the case of careful and judicious riders the sacrifice is abundantly justified.

In competitive yacht construction the saving of weight is not a matter of choice but of necessity, particularly in these latter days of the art, when the principles of design are so well known that in model and sail plan there will be comparatively little to choose between two rival yachts when they meet on the trial course. As far as the designer and builder are concerned, the contest has come to be one of weight-saving in construction; and the engineer can now claim yacht construction as one of the many arts which, like that of practical architecture, have called in his services and availed themselves of his knowledge of strains and the strength of materials. Thornycroft in England and Herreshoff in America had both achieved reputations in the construction of fast torpedo craft when the inevitable drift of ideas and events in yacht construction drove Lipton to the one and Iselin to the other in their endeavor to secure the ideal racing craft.

How closely Herreshoff and Thornycroft have crept to the danger line in the yachts "Defender," "Columbia," and "Shamrock" is suggested by the mishaps which have overtaken these boats in the course of their respective preliminary trials. In one race "Defender" carried away her gaff, in another the enormous strains on the shrouds caused them to cut into the masthead, and in a third race the steering gear collapsed. "Shamrock" at her launch is merely touched by the stem of a friendly tug which leaves a deep imprint in the frail metal of her hull. Later she goes out for a trial sail, and the breeze has scarcely filled her sails before the halliards part and the mainsail comes down on the run. On her first race she carries away her club topsail yard, and immediately after her start for America, something goes wrong with her bowsprit and she must needs put back for repairs.

And now it is "Columbia's" turn, and just what has happened to her is best understood by a glance at the two illustrations on our front page, one of which shows this lovely craft—by far the most beautiful that Herreshoff has ever turned out—under her full press of canvas, while the other proves on what a "slender thread"—in this case a slender stick—the integrity of that towering weight of spars and sailcloth depends. It was the case of the strength of the chain being equal to the strength of the weakest link—the link in this case proving to be the "port spreader," a slight pine stick which extends some 15 feet laterally at a point near the heel of the topmast and serves to "spread" the topmast and masthead shrouds and enable them to exert a more lateral and less vertical pull on these spars. When the spreader split, these shrouds slackened, and the enormous lateral pressure upon that towering pile of canvas, nearly 140 feet in height, fell upon the steel mainmast. While the mast was strong enough to stand the compressive strains thrown upon it by the pull of the shrouds, forestays, and backstays, it was quite unequal to the cross-bending strain when the shrouds were slacked up, and it promptly bent over and shut up, "after the fashion of a boy's tin putty blower," as some one expressed it, the wooden topmast snapping in two, and the whole mass of sails, rigging, mast and spars falling over to leeward in the picturesque confusion shown in our photograph of the wreck. No blame is to be attached to the steel mast, as a solid wooden spar would have proved equally helpless under like conditions.

There is a lesson in this circumstance which such a shrewd observer as Herreshoff will not fail to learn. While in the larger elements of a yacht, such as the hull and spars, weight may be judiciously saved to within a certain safe limit, there are smaller but very vital elements, such as the spreaders, the steering gear and certain details of the rigging, in which extreme economy of material may prove to be the very worst form of extravagance.

OUR FOREIGN TRADE FOR THE LAST FISCAL YEAR.

The trade of the last fiscal year is most astonishing and is a remarkable indication of the prosperity of the country. Our total imports for the year amount to $697,116,854. Of this sum, $211,869,918 was for articles of food and live animals; $221,998,377 was for articles in a crude condition which entered into the various processes of domestic industry; while only $108,621,406 was for articles manufactured ready for consumption; and what the Treasury Bureau of Statistics terms "articles of voluntary use, luxuries, etc.," amounted to only $93,914,635. Duty was collected on 43 per cent of everything imported and amounted to $206,507,812.

Our total exports amount in value to nearly twice our imports, the sum reaching the enormous total of $1,204,123,134. Of this sum, $784,999,009 was for products of agriculture, so that in this class alone our exports amount to a larger sum that all our total imports. Our exports of products of manufactures amounted to $338,667,794. Our products of mines exported amounted to $28,832,547. Our products of the forests exported amounted to $42,316,779. The fiscal year shows indeed a magnificent trade balance in our favor.

Manufactures are now becoming more than a third of our total domestic exports and the quantity and value are constantly increasing. Of this remarkable growth, the manufactures of iron and steel are the most striking. Out of a total increase in our exports of manufactures during the year which amount to about $48,000,000 in round numbers, $33,000,000 is in manufactures of iron and steel. The total exports of iron and steel manufactures for the fiscal year 1899 were $93,715,000, or more than three times as much as those of 1894. On the other hand, the imports of manufactures of iron and steel continue to fall, having been during the year $12,098,239 against $25,338,103 in 1896 and $53,544,372 in 1891; thus, while our exports in this line have been constantly growing, the imports have fallen, so that they are now less than one-half what they were in 1896 and about one-fifth what they were in 1891.

A NATIONAL PARK IN THE EAST.

The creation of a great national forestry and game reserve in northern Minnesota, embracing 7,000,000 acres around the headwaters of the Mississippi River, with many lakes of rare beauty, well stocked with fish, will be advocated before Congress next winter by prominent citizens of Chicago and Minnesota. The promoters of the plan are not likely to experience much difficulty in interesting Congress. The game and the virgin forests of the United States are disappearing so rapidly that it is exceedingly important that measures be taken, before it is too late, to save some of the great wooded areas of the continent.

It is one of the marked features of the legislative and popular indifference to their best interests common to those regions that such enterprises as this never originate in our Southern States. Yet there, it would seem, we have the most promising, most adaptable, and most accessible regions for such purposes to be found anywhere within our national limits. Nearly all of the forestry reserves that have been established up to the present time are in the far Northwest; the chief of them, the Yellowstone National Park, is inaccessible to the great majority of the people. Nothing of national scope is to be found east of the Mississippi River.

Within about a day's travel of New York, Philadelphia, Baltimore, Washington, and most of the Atlantic seaboard, and quite as accessible to Pittsburg, Cincinnati, Louisville, Indianapolis, and St. Louis, there are vast stretches of virgin forests—along the line of the Great Smoky Mountains, on the border between Tennessee and North Carolina—that are thoroughly suited to the purposes of a great game and forest preserve. Going up from the lowlands at Walhalla, S. C., to the high plateau surrounding Highlands, N. C., a stage trip of about thirty miles, the late Prof. Gray, the eminent botanist of Harvard, tells us that he encountered a greater number of species of indigenous trees than could be observed in a trip from Turkey to England, through Europe, or from the Atlantic coast to the Rocky Mountain plateau. The region surrounding that described by Prof. Gray, especially to the west, with the headwaters of the Tennessee, the French Broad, and the Savannah Rivers, all within a few miles of each other, with fertile valleys and mountain elevations of 5,000 feet or more, and a density of verdure unapproached elsewhere, is an ideal spot for a preserve, where every sort of North American animal or fish would thrive and where almost every tree or plant found within our borders from the Atlantic to the Pacific would grow uncared for. The land in this region is still purchasable "for a song," certainly at as little as or even less than that obtaining in the Northwest. The climate, while sufficiently severe in the winter to suit the more northern species of animal life, is never sufficiently so to kill great quantities of game, either by freezing or through lack of winter food, as is not uncommon in the Northwest woods.

Added to the climatic and the varied physical characteristics of this region, which especially fit it for the purposes in view, there is no like region obtainable where the varied and picturesque scenery so admirably adds to the desirability of the location. While these headwaters are singularly devoid of lakes, there are ample streams running through deep valleys and gorges which render the production of artificial lakes and reservoirs a matter of detail and of slight expenditure. Cascades and even waterfalls of very considerable dimensions abound on every hand, vast stretches of virgin forests, with an evergreen undergrowth of laurel, kalmia, rhododendron, etc., afford ample shelter and browsing for the winter, while the steep mountain sides, largely covered with bowlders and rocky ledges, from every cranny of which dense vegetation springs forth, furnish safe homes for all varieties of our smaller mammals.

A park that would take in the region along the Smoky Mountains around Clingman's Dome, or the southern slopes around where North and South Carolina and Georgia meet, in the middle of the headwaters of the Savannah River, or where Tennessee, North Carolina and Georgia meet, would not be misplaced. The timber and mineral wealth of the regions mentioned are such that it can only be a question of a few decades when these mountain slopes will be denuded and when the people of the vast valleys that depend on these watersheds for their water supply will suffer from the blindness of a generation that could not foresee the otherwise inevitable and combine its prevention with the benefits of an enduring national park in the populous East.

POSTAGE AND THE EXPORT TRADE.

A correspondent of ours from Sydney, N. S. W., has made a complaint regarding insufficient postage on matter sent to him from the United States, and we have also received complaints from so many other sources that at last it has become necessary to sound a note of warning which American manufacturers and exporters should heed. Our correspondent states that American firms are extremely careless in the matter of postage paid by them. He and his partner are native Americans, and understand American methods of doing business, and the bulk of their business is in American goods. They keep a mail book and enter every letter posted, and when an answer is received a check mark is entered after it and an account is kept whether a reply is received or not, or whether the letter is returned to the Dead Letter Office. He found on going back over this book that 20 per cent of the letters were never answered, and that in the matter of underpaid postage from the United States it has cost them on an average of $3 for each mail during the years the book has been kept. Often this amounts to from twenty-five cents to a dollar on circulars of absolutely no use to the firm of manufacturers' agents, importers, and commission merchants. They find that in twenty years only two failed to reply from English and Continental firms and in only three cases was their postage short. He strongly condemns American neglect and methods of business in this respect. Our export trade is now at the highest level which it has ever reached, and if we are to maintain our present satisfactory position it will be necessary for our manufacturers and importers to pay the strictest attention to all the minutiæ connected with the business. Our consuls abroad are constantly sending complaints regarding the lax business methods in correspondence and in the matter of postage. There is no difficulty in prepaying all matter sent abroad, so that an onerous burden is not placed on the recipient. Often small matters of this kind defeat the very end which the sender has in view.

THE PRODUCTION OF SLATE.

Various materials have been proposed to take the place of slate, but the ease with which this substance can be cleft assures for it a permanent use and it is interesting to note the actual importance of its production.

France holds an important place in this respect, and ranks second among the slate-producing countries. In Marne-et Loire the slate quarries produce annually about $4.000.000 worth. Her principal competitor up to the present has been the United Kingdom, where, in Wales, Cumberland, Westmoreland, Ireland, and the Isle of Man, are situated quarries whose production last year amounted to nearly $8,800,000. But it will soon be necessary to place the United States well up in

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the list of competitors, for this special industry has assumed considerable proportions here, and slate to the value of $3,600.000 is produced annually. Small quantities are also quarried in Canada, Belgium, Germany, and India. The estimated production of the entire world is valued at $16,600,000.

SOME SODA WATER FOUNTAIN STATISTICS.

The chemist who discovers a process of making a new drink and is successful in putting it on the market soon finds himself on the high road to financial success; but of the scores who are laboring in season and out of season to concoct some new mixture that will appeal to the taste of thousands of thirsty mortals not one per cent reaches the goal for which he is striving. Notwithstanding the popular craze for something new in cooling drinks in summer, and hot and bracing in winter, the number of successful drinks each season is very small indeed. Occasionally the large department stores will take up a new drink and advertise it extensively, and there will be a temporary rush for it which will make the profits large both for the dispenser and the inventor. But there is nothing in which the public refuses to be fooled for any length of time more than in the drinks which are consumed summer and winter. If a really new article of virtue is introduced the public stands by it, and there is a steady and constant demand for it; but most of the new mixtures are merely variations upon the old drinks intended to deceive the consumers.

The summer trade in soft drinks is peculiarly handicapped in this respect. It is already so loaded down with different sirups and drinks that dealers will not take hold of a new thing unless it can be demonstrated to possess unusual virtues, or the inventor of it is willing to put a lot of money in advertising it. The largest fountains, where the trade in soda water on a hot day amounts to a thousand or more glasses, have to carry in stock from fifty to one hundred different flavors. The majority of the customers will only call for a few different flavors, but the dispenser of drinks must be prepared to satisfy the crank who is bound to call for some odd flavor if it happens to be out. It is to prevent the expansion of this already too formidable list of sirups that the trade is opposed to the indiscriminate introduction of anything new.

On the other hand new drinks are put on the market every season, but these are often the result of a little independent work on the part of the owner of the fountain. It is an easy matter for him to concoct a new drink. His knowledge of sirups, waters and chemicals enables him to mix different ingredients together which will produce a flavor peculiar to itself. It may have no other virtue. But if it is properly named and skillfully advertised, it may have a "run" or a season that will pay big profits. The soda water man does not expect a permanent trade in it; he is satisfied if it will take for a few weeks or months. Usually the drink is one that does not cost much to make. Enterprising druggists and department stores in the shopping districts get out these special drinks, which can be obtained nowhere else, and publish them in a little pamphlet to distribute among customers or on the street. It is remarkable what this little advertising will do on some hot days. The wording of the advertisement must, of course, be unique and attractive, and the name given to the drinks appropriate to the season and location. One druggist confessed that he caused a run on a simple and harmless drink in this way that averaged a sale of 500 glasses a day through July, and some of the big department stores must even exceed this.

The shopping district is the best all-round soda water district in the city. Down town in the business district the soda water season is short; comparatively few men will call for this typical American drink except in very hot weather. Then the stores do a rushing trade, especially in the phosphates. A phosphate soda is considered about as harmless a cold drink on a hot day as any concoction yet devised, and it quenches the thirst as well. Consequently, staid and sober business men will indulge in one or more glasses of this drink in preference to clear ice water. On the hot days, some of the large down town drug stores sell a thousand or two drinks, chiefly of plain soda and phosphates. Ice-cream soda is not a man's favorite drink, but up town in the shopping district it outclasses almost all other drinks. It has a long season, beginning early in the spring and lasting until cold weather comes. The department stores make a specialty of the ice cream soda because it is in such general demand; but on the whole it is not as profitable as the plainer drinks. The reason for this is not that the cream costs so much more, but because of the amount of time required to consume it. Time is everything to the soda water man on a hot day. With new customers crowding and jostling each other to reach the counter, it is money in his pocket to get rid of consumers as quickly as possible. It takes a woman considerable time to eat and drink her glass of ice cream soda. Usually she expects to make this an excuse to rest and gossip, and she may occupy her seat at the table or counter for ten or fifteen minutes. In that length of time a dozen or more sodas could have been dispensed to new customers who would like to take their places. So as a matter of business the ice cream soda is not a favorite with the soda water man in the hot weather. Some absolutely refuse to serve it, except on ordinary days when there are no crowds. It is convenient to be out of ice cream when the mercury is climbing up among the nineties.

The largest recorded day's business in soda was made on one of the hot days in June, when one down town drug store, which keeps open all night, sold over its counter 8,000 glasses of soda and soft drinks. There were many other stores which sold from 3,000 to 5,000 glasses. Such records are not made often, but there are always from a dozen to twenty days in each summer when the average thus runs high. During the rest of the season the demand is what is called moderate, but in reality the profits are enormous.

In former days the few manufacturers of soda water controlled nearly the whole trade in sirups and all carbonated waters. To make more of a monopoly of it, and to hold on to customers, the manufacturers supplied their customers with elaborate fountains and signs. The only stipulation was that the customer bought his soda from the manufacturer. The outfits did not go out of the possession of the manufacturers, and could be taken to another customer if the soda water man failed to live up to his agreement. The cost of these plants, with their handsome marble fronts and plate glass sides, ran all the way from $500 to $10,000 and $15.000. To-day most of the department stores and druggists order their own fountains and owe allegiance to no company. More than that, they do not even patronize the companies to the extent of purchasing sirups or carbonated water from them. They have their own carbonating plant and make their own sirups. A complete carbonating plant can be put in for a few hundred dollars, and after once installed the cost of making the soda water is very small. The firms who supply the carbonated waters in portable tanks charge from eight to ten cents a gallon, but the druggist can make his own beverage at less than three cents per gallon. Where large quantities are used, the difference in the original cost is so great that the saving will almost pay for the equipping of a carbonating plant in one summer.

With the carbonated water thus reduced to three cents a gallon, the profit on a glass of soda water is great. The sirups and cream represent a greater cost than the water itself; but where the flavoring extracts are made right in the store a glass of plain soda with any of the ordinary sirups does not cost the dealer more than a cent and a half. A good glass of ice cream soda cannot be made for less than three to five cents. The latter is usually the average cost in high class stores where the best of cream is used. The price of ten cents a glass, considering the slowness with which consumers drink it, does not make the profit so large as an ordinary plain soda.

The soda water fountain is an American product, but there is reason to suppose that other countries are gradually contracting our national taste for this summer beverage. One large firm makes a business of manufacturing a certain type of soda water fountain and carbonating plant for export. The South American countries in particular show a growing penchant for soda water. A good many of the old-fashioned, discarded soda water fountains find their way to South America and even to South Africa. The demands of the trade are such that every druggist in the city aspires to have constructed for his store a fountain of superior size and taste, and this causes many old fountains to be thrown upon the market. Formerly these were sold to the small country dealers, but now a considerable number of them are bought up by the second hand dealers for the export trade. G. E. W.

IMPROVEMENTS IN OUR TOBACCO.

The Department of Agriculture has now a number of experts at work on the question of improving our tobacco and making it as desirable for consumption as that imported. We do not know of any subject to which the department could devote its attention which would bring back such a large financial return as the improvement in our domestic tobacco, which will dispense with the importation of such vast quantities of wrappers and filling tobacco. The Sumatra leaf, while not relished by all smokers, is a most economical wrapper-leaf. It is good in color, and a pound will cover many more cigars than the domestic product. The Havana wrapper is a great favorite, owing to its color and incomparable flavor. To compete with these imported wrappers the American producer must furnish a leaf which will resemble the others in appearance and which will be fully equal in flavor. It is not so difficult for them to accomplish the former as the latter, and whatever is deficient in soil and climate must be supplied artificially, and the government experts are working on this line, and by change of soil, fertilization, hybridization and breeding it is possible that the effect can be produced. Of course, it will take many years to grow a nearly perfect leaf by artificial means.

SCIENCE NOTES.

Lord Kelvin is to resign the chair of Natural Philosophy in Glasgow University, which he has held for so many years with such honor to the University.

The Chilean government is fitting up a state vessel for the exhibition of national products and manufactures for the purpose of making them known abroad. The principal ports on the Pacific will be called at first.

Mr. Benjamin Hoppin has forwarded his pleasure yacht "Senta" to Greenland as a gift to the Peary relief expedition. Mr. Hoppin gives this yacht without any restrictions as to its use, except that he desires to have it used in scientific research.

It is expected that the wheat harvest in Europe will be about as good as that of last year. The Statist estimates that importing countries will require 210,000,000 bushels from America, out of 250,000,000 bushels which the United States is expected to have for export in reserve.

A curious story comes from Turkey. A German firm sent some textile goods wrapped in old newspapers. The Custom House officers noticed this fact and informed the censor, who promptly decreed that the articles had to be unpacked and repacked without the newspapers, and this was done.

International expositions are not always a financial success, but the one at Turin seems to have been an exception. The shareholders were all paid in full and there was 140,000 left over. Naturally the city was a great gainer by the exposition, as it is estimated that more than 1,000,000 strangers visited it.

The late Robert Bonner was a famous compositor. One day, for a wager, he set and corrected 25.500 ems of solid minion in twenty hours and twenty-eight minutes. The greatest record which he ever made was setting and correcting 33,000 ems in twenty-four hours, an average of about 1,376 ems per hour.

The third International Astronomical Conference will be held at the Yerkes Observatory, Williams Bay, Wis., September 6, 7 and 8. Prominent astronomers from this country and Europe will be present. A permanent organization will be effected at the coming meeting, and arrangements to hold the annual meetings at the larger observatories will be made.

Surgeon Beck, of the Thirteenth Minnesota, states that the small caliber Mauser bullets rarely fracture a limb and that he knows of fully a hundred men shot through the chest cavity in every portion except the heart who recovered. Abdominal wounds are, however, nearly always fatal. Interesting details on "Bullet Wounds in Modern Warfare" will be found in the current number of the SUPPLEMENT.

Preparations are now being made for the Passion Play, which will be held at Oberammergau in 1900. The last Passion Play was given in 1890, and was a success financially and artistically. Singers have been selected and some of the actors who are to take important parts. Anton Lang will probably take the part of Christ. The committee has decided to erect new buildings, and the auditorium is to be covered with an iron roof. This was very essential, as many of those who visited the play nine years ago found their pleasure in it greatly marred by the fierce rays of the sun beating down upon them.

The Seventh International Geographers' Congress will meet in Berlin, September 28, and will hold sessions until October 4. These will be held in the new building of the House of Deputies. General meetings will be held in the mornings, special meetings in the afternoons, and the evenings will be devoted to social gatherings. Only twenty minutes will be allowed for the reading of any paper, though exceptions can be made to this in cases of subjects of universal interest. German, English, French, and Italian will be the only languages permitted. The "Protektor" of the Congress is Prince Albrecht of Prussia, and among the vice-presidents are the King of Belgium, the Prince of Wales, Crown Prince of Denmark, etc. Among the honorary vice-presidents is General Greely.

The Chief of Police of Jersey City has hit upon a novel plan for entertaining the poor of the city and giving them enjoyment during the hot summer months. He proposes to give a series of open air dances for the public in different parts of the city. The plan does not entail the expense of hiring hot, stuffy halls, but he intends to utilize the asphalt pavement for dancing purposes. He proposes to take a block of asphalt pavement and have it perfectly cleaned, then traffic will be suspended on it until the dance is over. The block will be roped in to keep out traffic and the rough element that might interfere with the dancers. Music will be furnished by a band which is hired to give free concerts. In nearly all large cities the municipalities are doing a great deal for the pleasure of the poor, and schemes like the present cannot be too warmly commended. The recreation piers which have been opened in New York city have been a great boon to the poor and have undoubtedly saved the lives of many children.

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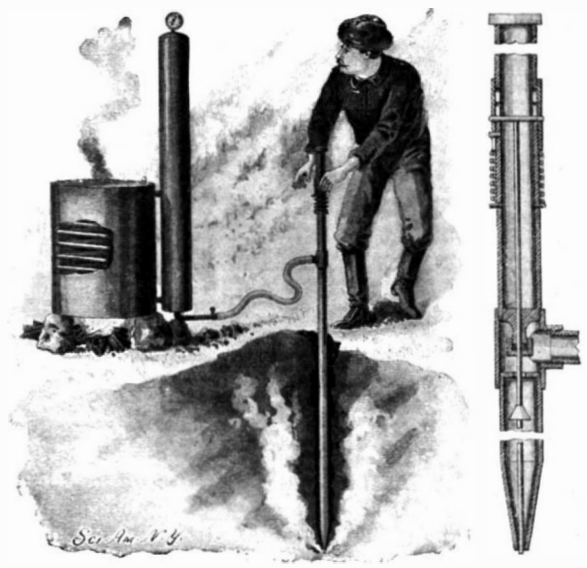
A NEW MINER'S DRILL.

In the accompanying illustrations we present a drill for miners, which is constructed to permit the passage of hot water or steam to the point of the drill, so that frozen ground may be readily thawed.

Referring to the sectional view, it will be seen that the drill-point is hollow and is provided with a steam-pipe supplied from a boiler. The admission of steam is controlled by a valve, the stem of which runs down to the point and up through the handle-bar, where it is provided with a cross-pin engaging slots in a spring-



MINER'S DRILLING AND THAWING DEVICE.

pressed sleeve, which can be either turned or moved longitudinally, owing to the key-hole form of the slots. In admitting steam to the drill-point, the sleeve is forced down against its spring so as to unseat the valve and permit the steam to thaw the frozen ground and to wash out the precious metals.

Should the hollow drill-point be clogged, the obstruction may be readily removed by pushing down the lower extension of the valve-stem. The downward movement of the sleeve is limited by a stop-pin projecting from the handle-bar and adapted to be engaged by a slot. When the stop-pin is in register with its slot, the sleeve can be moved down to the maximum distance, so that in addition to the unseating of the valve, the lower extension of the stem is pushed through the hollow spout. But when it is desired merely to unseat the valve without cleaning the point, the sleeve is turned so as to move the stop-pin out of register with its slot and to cause it to limit the downward movement of the sleeve.

The valve is under the complete control of the operator, for when he grasps the sleeve to force the drill into the ground the valve will open, but will immediately close when he relieves the pressure.

The inventor of this drill is Mr. Rufus E. Farrington, of Phœnix, Arizona Territory.

THE CRANKSHAFTS OF THE LINER "DEUTSCHLAND."

The accompanying photograph represents a piece of finished steelwork which is entitled to take its place among the things which are dignified with the title of "Largest in the World." It represents one of the crankshafts of what will be the most powerful twin-screw marine engines ever built. This shaft and its mate have recently been completed by the celebrated Krupp Company for the steamer "Deutschland," which is now building for the Hamburg American line. Each of the engines of this ship is designed to develop 17,500 horse power, and the two together are expected to drive the great ship at a speed of 23½ knots per hour on her trial trip, and to give her a sustained sea speed of 23 knots per hour. There is nowhere in the world, either ashore or afloat, a crankshaft which delivers anything like as much as 17,500 horse power, the nearest approach to it, we believe, being found in the Cunard steamers "Etruria" and "Umbria," whose engines are of the single screw type and develop ordinarily about 13,000 horse power on a single shaft. The great size of this piece of work is best appreciated by comparing it with the man who is shown standing beside one of the cranks. The diameter of the shaft is 25·2 inches; the stroke of all four cranks is 72·84 inches, and the total length of the shaft over all is 59 feet 3⅜ inches, while its total weight is 223,300 pounds. The nickel steel of which it is made has shown an ultimate breaking strength of 132 pounds to the square inch, with an elongation of 20 per cent in a length of 8 inches. In our issue of July 1 we gave some illustrations showing the construction of the keel and cellular double bottom of this ship. The chief dimensions of the "Deutschland" are as follows: length over all, 686½ feet; length on the water line, 662 feet; beam, 67 feet 4 inches; and depth, 44 feet. The ship will have sleeping accommodations for 1,320 people, and while not so long as the "Oceanic," whose total length is 704 feet, she will have about 3 knots greater speed and, of course, a considerably larger total of horse power. We are indebted to Mr. Emil S. Boas for our illustration and particulars.

THE "POLYPHONE"—ATTACHMENT FOR PHONOGRAPHS.

One of the simplest and at the same time one of the most ingenious attachments for talking-machines which has yet appeared is found in the "polyphone," a phonograph sold by the Talking-Machine Company, of 107 Madison Street, Chicago, Ill.

It has long been a well known acoustic principle that when a sound has been reflected or repeated within an exceedingly short interval of time, the original and the repetition sound in unison. The makers of stringed musical instruments apply this principle by using sounding boards, upon the resonance of which the quality of the tone depends. In the "polyphone" a similar principle is employed.

"The "polyphone" is fitted with two diaphragms and two styli arranged one in front of the other so that the same sound is twice produced. At first blush it might appear that one diaphragm would reproduce one word and the second another word. But when it is considered that the cylinder makes two revolutions in a single second, it is evident that the interval between the two sounds is so small that the repetition and the original practically coincide. Since the repeated sound is equal in volume to the initial sound, it follows that the "polyphone" is capable of reproducing a word with twice the loudness of the ordinary phonograph. In addition to this increased volume the use of two diaphragms imparts to the sound that quality which, as before remarked, depends upon the application of the principle of resonance or of repetition.

The double diaphragm can be applied to any phonograph whatever, so that any ordinary talking-machine can be converted into a polyphone.

THE "POLYPHONE"—NOVEL ATTACHMENT FOR PHONOGRAPHS.

The Meeting of the International Acetylene Association.

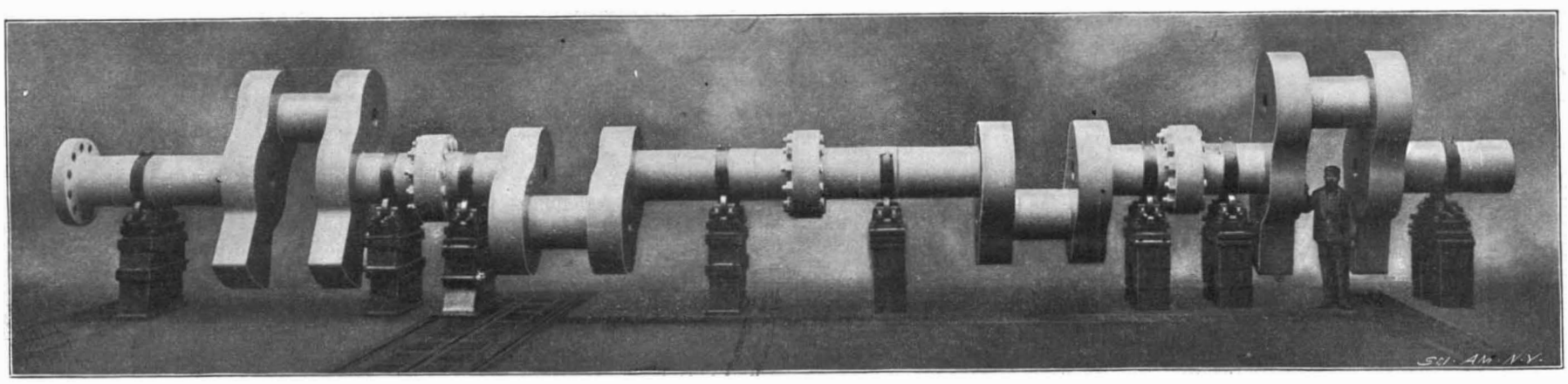
The annual meeting of the International Acetylene Association was held in Chicago, July 11. The scope of the association was extended to include, in addition to manufacturers of gas generators and carbide, manufacturers of burners and other acetylene supplies. Arrangements were also made to permit individuals, inventors, etc., who were interested in the development of acetylene illumination to become associate members. The Acetylene Gas Journal, of Buffalo, was made the official organ of the association. The opinion was general that the acetylene business was on the eve of a very prosperous season, although the problems to be faced and overcome are such that establishments of small capital and experience are almost certain to meet disaster unless they feel their way very carefully. The president is George Landis Wilson; vice-president, W. T. Reynolds; and the secretary and treasurer is J. B. Carroll.

The Value of Small Inventions.

The inventor of the roller skate made £200,000. The gimlet-pointed screw has been responsible for more wealth than most silver mines. One hundred thousand pounds in first-class securities would not represent the fortune made by the man who first thought of copper tips to children's shoes. Even a little thing like the common needle threader is worth £2,000 a year to its owner, while the "Return ball"—a wooden ball fastened on a piece of elastic—yields £10,000 per annum; this is only one of many profitable toys.

We may mention the "Dancing Jim Crow," which produces £15,000 a year; the "Wheel of Life," worth in all fully £100,000; the walking figure "John Gilpin," and the "Chameleon top." The sale of the last named toy has been enormous, and the profits also enormous. Indeed, the "Chameleon top," as a profitable invention, has probably excelled any one discovery in modern times, however valuable and important this may have been. As far as profits are concerned, the invention of toys pays better than those of anything else.

Money has been, and always can be, made more easily out of simple patented inventions than out of any investment or occupation. Great discoveries take so many years and cost so much to perfect that the fortunes made from them are small compared with those we have instanced. The man who discovered that a candle, if tapered at the end, would stick firmly into its socket, patented the idea and afterward founded the largest candle factory in the world. Might not any one have thought of this simple device? Out of the millions who own umbrellas, how many realize that these unfortunately indispensable articles represent wealth untold! The frame, the cover, the materials used, all are the result of numberless experiments and patents. An umbrella years ago used to be made of whalebone and gingham. It weighed as much as a portmanteau. Alpaca was substituted for gingham, then silk for alpaca. Each change meant a fortune to the inventor who brought it about. For a long time the ribs were solid; then Samuel Fox arose, took the umbrella and cut grooves along its ribs. He designed the "Patent Paragon Frame," and lived to see his invention used universally. At the death of Samuel Fox his heir benefited to the extent of £179,000—the residue of a total profit of at least half a million.—Patent Record.



NICKEL-STEEL, QUADRUPLE CRANKSHAFT FOR THE "DEUTSCHLAND."

Stroke, 72·84 inches; diameter, 25·2 inches; weight, 223,300 pounds.

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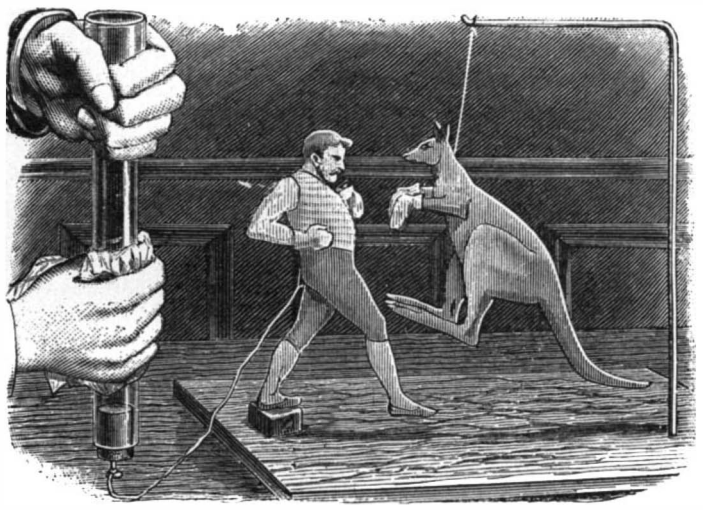
THE BOXING KANGAROO.

As is well known, the electric pendulum consists of a very light ball of pith which is suspended by means of a silk thread from an iron wire that is bent at right angles, the longer leg of the angle being placed in a glass foot for the sake of insulation. If the little ball is approached by any object charged with electricity, it is at first attracted and then, upon being touched, is repulsed by it. The accompanying illustration, for which we are indebted to our worthy contemporary, the Illustrirte Welt, shows an original way of presenting this old principle. The figure of a boxer is cut out of a visiting card and covered on the back with tin-foil, which is cut a little larger than the figure, so that it can be turned over the edges of the card. One foot of the figure is stuck into sealing wax on a small block, and to the back of this leg is secured a piece of iron wire. As the other foot does not touch the support, it is insulated from it. The figure of a boxing kangaroo in position for making an attack is now cut out of tracing paper. This figure is also covered on one side with tin-foil and then is suspended by a linen thread from one end of a piece of iron wire that has a rectangular bend, the other end being set in the supporting plate so that the kangaroo shall face the boxer, as shown in the engraving. In order to obtain the necessary electricity, we take a glass lamp chimney, stop one end of it by means of a cork, and in the center of the cork drive a nail to which is secured one end of a piece of small iron wire, the other end of the wire being connected with the wire on the back of the boxer's leg. Now our apparatus is complete. After the lamp chimney has been carefully dried it is rubbed with a piece of silk or fur, thus generating electricity, which is transmitted to the boxer. The kangaroo is strongly attracted by the figure thus charged with electricity, which it attacks, but a discharge of electricity takes place at once and the animal is repulsed. This is followed by a series of attacks and repulses, the struggle between the man and beast being constantly renewed as long as the rubbing of the chimney is continued.



THE BOXING KANGAROO.

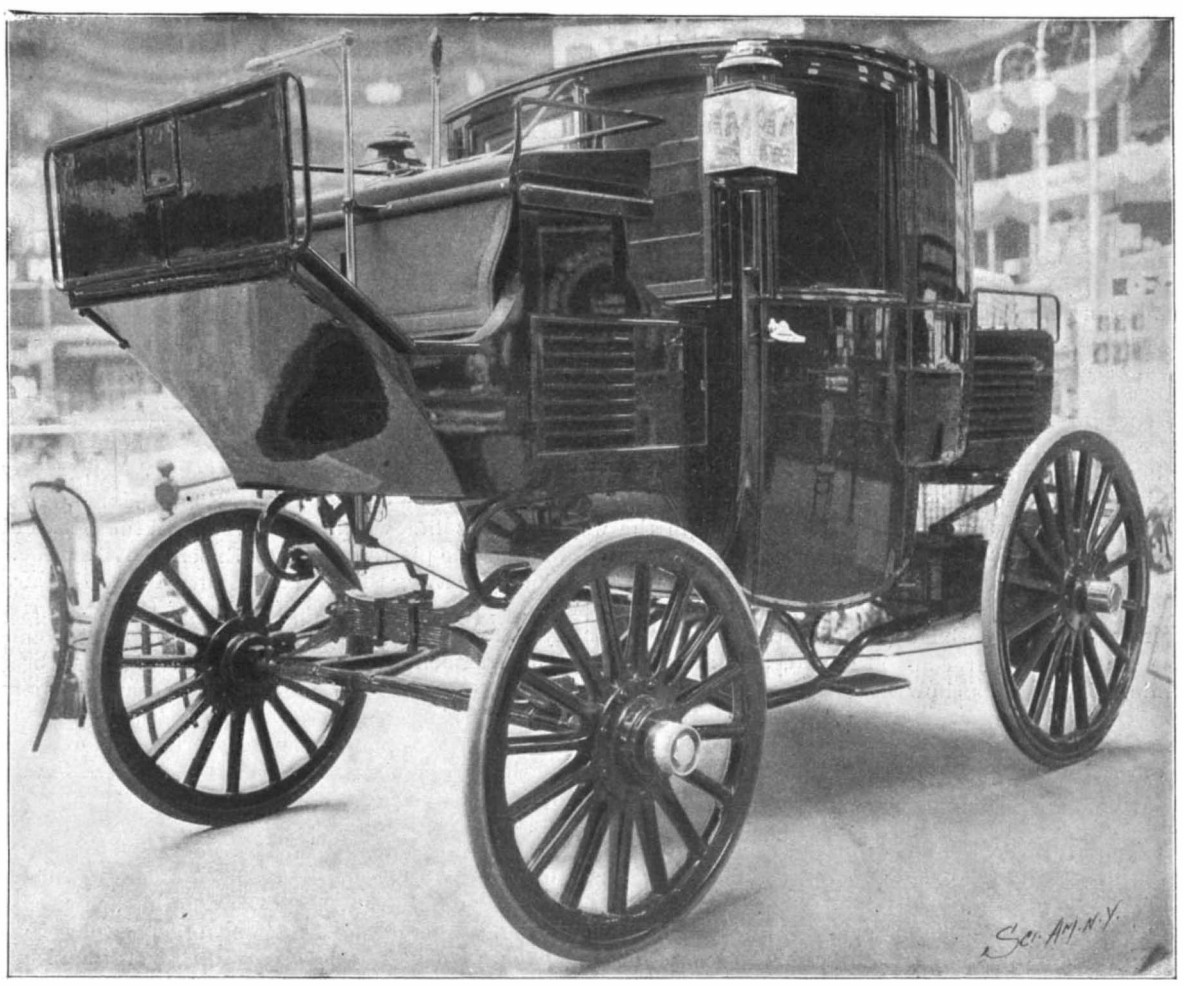
AN ELECTRIC BROUGHAM.

Among the numerous automobiles exhibited at the electric show in this city recently was a peculiarly designed electric brougham built by the Riker Electric Motor Company.

It will be noticed that the storage batteries are distributed equally at the front and rear of the body, one portion under the driver's seat and the other in a rear box, the top of which is covered with slats intended for holding trunks and baggage.

It is said this is a pattern used considerably in Paris, where this vehicle was to be sent. The interior is richly upholstered and is equipped with electric lights and other conveniences found in modern coaches.

The vertical driving lever for operating the controller switch is located at the center of driver's seat as well as the steering lever. A combined volt and ampere meter is fixed in front of the driver at the foot of the dashboard. The current from the battery is applied to two motors attached to the rear axle, each having a capacity of 2 kilowatts, whose pinions engage the gear circular rack attached to the interior face of the solid rubber-tired rear wheels. The weight of the vehicle is 4,000 pounds. It travels at three different speeds, the highest being at the rate of 10 miles per hour. The battery after one charging is good for a distance of 25 miles on a level macadam road. For city use it is found to be more economical than a pair of horses, and occupies less ground space than the usual coach and team.



THE RIKER ELECTRIC BROUGHAM.

The Age of Yew Trees.

It is believed that the yew tree even exceeds the oak in age. In England and Ireland it is nothing unusual to find yew trees which, according to authentic accounts, date from 1000 A. D. Many of these trees are celebrated in history and legend. There is an immense yew tree in Wiltshire with a hollow trunk capable of accommodating a breakfast party. In England yew trees are frequently planted in church yards, and it is probable that this is the result of the somber and funereal aspect of the tree, which renders it particularly appropriate to places of sepulcher.

Nature-Study at Cornell.

BY ALICE DINSMORE.

Nature-study, according to Prof. Bailey, "is seeing things which one looks at, and the drawing of proper conclusions from what one sees." A simple enough thing to do, it would seem, and yet really so difficult, that the College of Agriculture of Cornell is holding a summer school in the art. It is free to teachers in New York State, but open to others on payment of tuition, and more than a hundred students have availed themselves of its advantages this season.

The instruction is divided among three departments: in insect life, in plant life and in farm work. Prof. Comstock, the entomologist, directs the study of insects. He or Assistant Prof. A. B. Comstock lectures an hour two mornings a week. "The metamorphoses of insects," "the grasshopper," "the cicada," are among the subjects that have been discussed, and the lectures are fully illustrated by charts, drawings and cabinet specimens. Not only is the life history of an insect told, but interesting side-lights and latest discoveries not yet recorded in books are added.

The lecture ended, the class is divided into sections, each led by an instructor, and goes out with nets and cyanide bottles to find specimens in as many states of development as possible. These are brought back to the laboratory, where each student has a breeding cage made of a flower pot with sod and foliage in it, covered with a large lantern globe made tight with muslin tied over the top. In this insects are put, so that their manner of life may be watched. Later in the day, an insect is dissected and drawn in whole and in parts, so that his curious anatomy and functions are understood as is possible in no other way.

Prof. Bailey's instruction in plants is along similar lines and by like methods. The excursions to the border of Cayuga Lake where aquatic life can be observed in its little known habitat, visits to the numerous wild and beautiful gorges in the vicinity, and to the gardens and forcing houses on the Campus are among the most profitable exercises in this department. The beautiful and the ethical, the egoistic and altruistic sides of plant life are all brought to the attention of the students.

Many find a day with Prof. Roberts on the farm the most interesting of the whole week. He, too, begins with a lecture: "Cereals and the potato." He includes in it directions about soils and fertilizers, manner of planting or sowing and cultivation, and illustrated by blackboard drawings, root growth, etc. The scene of his later instruction may be in a barn or a hay meadow or a potato field, or elsewhere as suits his subject. He also gives a great variety of useful lessons on the best means of raising both plants and animals, also in regard to farm management and the beautifying of farm houses.

The professors and instructors are all enthusiastic in their departments, and they find eager response from a large number of the teachers who are studying.

Each student arranges captured insects in a case. Some are making collections of plants. All who wish are to have specimens of soil to take home.

The ultimate aim of the College of Agriculture is very far-reaching. It is believed that when these teachers begin their work in September, it will be with so fresh and intelligent an interest in out-door life, that they will plan to get a few minutes a day with their pupils in the study of these common but little understood subjects. Thus, it is hoped, children will be encouraged to watch the strange and beautiful changes going on about them in field and air and forest.

But most of all, it is hoped that the large outcome will be such a love for the country on the part of the boys and girls now in the schools that they will prefer to stay on the home farm instead of leaving it for the city; or, if it is their misfortune to be city-bred, that when they can have homes of their own, they will choose them in the country.

In short, this is the latest effort toward the solution of the "abandoned farm" problem.

Yellow Fever Researches.

The present outbreak of yellow fever at the Soldiers' Home at Hampton, Va., gives an excellent opportunity for the members of the army medical corps to carry on investigations as to the nature of yellow fever, which they have already been prosecuting for the last two years. At present the medical world seems to be of the opinion that the specific bacillus of yellow fever has not been satisfactorily identified, notwithstanding the announcement that Dr. Sanarelli has segregated the germ of yellow fever. Surgeon-General Sternberg of the United States army has isolated the bacillus, which he terms for convenience "bacillus X." It is not claimed that this is the specific germ of yellow fever, but only one which is worthy of closer study. The surgeons of the Marine Hospital Service who have been studying the question in Cuba will soon make public a report on the matter. It is believed that their conclusions will be identical with those of Sanarelli. Dr. Doty, Health Officer of New York, is carrying on experiments with a serum for the destruction of the bacillus discovered by Sanarelli.

THE St. Clair and Erie Ship Canal project involves building a canal across the narrow neck of land separating Lake St. Clair and Lake Erie; the distance is only thirteen miles. The construction of this canal would save seventy-nine miles of dangerous lake and river navigation. The canal would be of great advantage to the United States shipping. The shipping passing through Detroit amounts to 32,000,000 tons per annum, and it is estimated that at least two-thirds of this amount would use the canal. The Canadian Engineer claims there would be a saving of $1,014,000 a year to the vessel-owners by reason of the shorter and safer route via the canal.

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Correspondence.

The Air Resistance Question.

To the Editor of the Scientific American:

I have read with much interest Mr. Cleveland's criticisms and conclusions concerning the Air Resistance Question, and while he, in a seemingly correct manner, obtains results absurdly large, a few facts borne in mind will, I think, tend to reduce these figures to a more reasonable size.

Nearly all formulas for the determination of wind pressure at different speeds are based on the assumption that the resistance encountered (other things being equal) is directly proportional to the area, or to express it mathematically: $P = KSV^2$ in which P = pressure in pounds, S = surface in square feet, V = velocity in miles per hour, K = some constant. Experiments, however, seem to show that as S increases, K would have to decrease, in order that the equation should hold true, and that therefore either P does not vary directly as S, or that K has been given too large a value in the experiments, which have usually been performed with comparatively small areas. Prof. Kernot says: "Experiments at the Forth Bridge showed that the average pressure on surfaces as large as railway carriages, houses, or bridges never exceeded two-thirds of that upon small surfaces of one or two square feet, such as have been used at observatories, and also that an inertia effect, which is frequently overlooked, may cause some forms of anemometers to give false results enormously exceeding the correct indications."

If the first of our conclusions, viz., that P does not vary directly as S, be correct, then Mr. Cleveland's figures are too large, and probably exceed the right number by at least one-third of their value. If the second conclusion, viz., that K is too large, be true, then, Mr. Editor, your results are too big. A little calculation shows that to obtain the pressure of 15 pounds per square foot at 60 miles an hour, the value of K would be about 0·004. As a number of authorities make K less than 0·004, it is quite possible that this figure is too large. Whipple and Dines made it to be 0·0029, and it has been placed as low as 0·0014. Moreover, the fact that you obtained such large results in your computations of the air resistance of a bicycle and rider goes to prove that the formula is too large for even small areas, and hence that K should be reduced. Of course, if the air resistance of the bicycle and rider were made too high, that encountered by the train was also correspondingly large.

Tiffin, Ohio. Harry F. Stratton.

Air Resistance to Moving Bodies.

To the Editor of the Scientific American:

Everyone is familiar with the spectacle of brakemen, in the performance of their duties, walking or running along the tops of swiftly moving box cars; and it is also a matter of common knowledge that empty cars of this type, when released on moderately descending grades, in spite of the large surfaces presented to air resistance, and with no propelling energy except that generated by their own gravity, yet attain enormous velocities, and in numbers of cases with men riding in this same exposed position on their tops. The air pressure against a surface equal to that of an erect human body in such a position, if it amounted to a fraction of the commonly accepted estimates, would sweep these men with the violence of a tornado to the ground.

To put one's head out of a car window, moving at a speed of 80 miles an hour, does not even involve the danger of losing a properly adjusted hat or cap, much less that of losing the scalp or the head itself. During the test of a high speed locomotive on the Intercolonial Railway, a few months ago, the writer was standing on the steps of the rear car of the train, moving at a speed of over 90 miles per hour, and, in order to watch a danger signal in front, it was necessary to lean far outward, but no air currents sufficient to remove a light summer hat were encountered, although some drops of rain, which were falling at the time, would occasionally sting the skin with the sharpness of a whip lash. Evidently the larger ones did not attain the full velocity of the air currents in falling through them. Even at a distance of 10 feet from a swiftly passing train the writer has often noticed a current of air fully equal to that experienced on a train moving at the same speed, and everyone has noticed the herbage by the roadside, waving in the air currents at considerable distances from the train. These facts show conclusively that a large body of air, extending many feet in all directions, but moving at gradually decreasing velocities at increasing distances therefrom, is disturbed by the passage of a train. We must therefore conclude that a thin stratum of air immediately enveloping the train, as, indeed, we may all know from personal observation, is moving at practically the same velocity as the train itself. The eddying currents of air between the ends of the cars must of course exert an equal pressure against both surfaces, and therefore add nothing to the load of the engine. How much power is required to continuously disturb such a large body of air is the question that should interest railroad managers, rather than that of determining the frictional resistance against the walls of the train.

It is probable that the greatest exertion demanded of Murphy, in his race behind the locomotive, was for the rapid movement of his legs. The air resistance was removed by the train, and the frictional resistance must have been very small indeed, and, aside from the work of speed acceleration, it is therefore probable, if he had used a more highly geared wheel, that he could have duplicated any pace set by the locomotive, at his leisure.

Wind currents cannot be regarded as wholly analogous to those generated by moving bodies, because the entire atmosphere within their zone of disturbance must be subjected to a considerable degree of condensation, and therefore the pressures, against stationary objects exposed to their action, must be correspondingly increased. W. F. Cleveland.

Moncton, N. B., Canada.

An Improved Method of Studying Underground Insects.

By Prof. John B. Smith, Sc.D.

Concerning the life habits of underground insects we are yet greatly in the dark, and much of our supposed knowledge is really inference from observations made upon the insects when at the surface or from such excavating as has been done in attempting to follow out the burrows of diggers. This method is satisfactory in soils which are tough like clay, or hardened like the "dobe" of the Southwest; but it fails almost completely on lighter soils, even when assisted by a straw or grass guide. Concerning insects that make a straight burrow we have some information that is reliable; but as soon as lateral galleries or chambers are involved we begin to infer and direct observation becomes difficult if not impossible.

During part of the summer and fall of 1897 and the spring and summer of 1898 a large number of experiments were made with plaster of Paris of the finest obtainable quality, pouring it mixed with water into insect burrows and digging out the cast after it had set. This method was originally proposed by Mr. J. Turner Brakeley, of Bordentown, N. J., and a great number of experiments were made by him before the best mixture was finally decided upon. Subsequently Mr. Brakeley and myself made careful studies of several species of digging bees, of burrowing spiders and of the underground larvæ of certain Coleoptera. The results of these investigations were very interesting and proved that some of the forms had a much more complicated life history than had been supposed; also particularly as to certain digging bees, that what had been published about their habits was almost entirely erroneous.

The method of work, after the experiments had once developed it, is very simple. Having located the burrow which is to be studied, the first point is to clear out the edges at the surface so as to give a clean mouth into which there is no danger of running sand or other material that will obstruct the free flow of plaster. The amount of material needed is, of course, a matter of estimate and it depends upon the experience of the operator as to how nearly he hits it. The dry plaster is first measured into a large tumbler or other receptacle with a pointed lip and water equal in measurement is then added; that is, equal parts by measure of water and plaster are mixed together. The mass must be rapidly stirred and thoroughly mixed, so that it pours evenly and as smoothly as water itself. The pouring must be careful so as not to obstruct the opening, and a little experience is necessary to enable the operator to run a small steady stream into an opening less than ¼ of an inch in diameter. The liquid plaster sinks at once to the lowest depths of the burrow and fills up, entering every lateral and every cell that is not actually closed; while the water soaks into the soil, leaving a cast that becomes hard enough to dig out in half an hour at the latest. I have poured 8 ounces of plaster into an opening about ¼ of an inch in diameter, reaching depths fully 5 feet below the surface, filling cell clusters made by digging bees, and all laterals of any kind connected with the main burrow. Anything in the way of insect life within the burrows is, of course, embedded in the plaster, and in that way we can get information concerning the actual food habits of predatory species. Thus, in the case of spiders, the owner will usually be found in the cast at the end, and around it will be fragments of the insects that have been devoured, giving a perfect representation of food habits. The plaster fills the burrow completely, and when dug out we have the opportunity of studying individual peculiarities, where there are any, and of getting at the general type by a comparison of a large number of examples. Thus it is found that some burrowing spiders have a distinct enlargement toward the middle of their tube, while others narrow it at some point near the middle and have a large chamber at or near the bottom. Where there is a silk lining this is held by the plaster and can be taken out completely with the cast.

Taking out a cast requires experience and sometimes much hard work. It is astonishing how deeply some of the bees go beneath the surface and how many lateral chambers or burrows they will make. One of the species studied by Mr. Brakeley and myself, not half an inch and no more than ⅛ of an inch in diameter, makes burrows in the course of its lifetime which will foot up to between 12 to 15 feet of ¼-inch tubing. Weighing less than a grain, it moves many thousand times its own weight in the course of its work, besides providing for from six to twenty descendants. This method also gives us the possibility of following out the history of a species at different periods of its life; and making casts at intervals during the season, the actual progress made by the insects can be ascertained and the order of their work definitely established.

The results of this sort of continuous observation are very prettily illustrated in the life history of one of the Andrenid bees. Andrena, according to published accounts, makes a vertical burrow extending down a variable distance from the surface; then makes a lateral cell, fills it with food, lays an egg, seals the cell, and digs another at some distance below it; continuing this until a sufficient depth has been reached. The idea is, of course, that the upper cell being first loaded will develop first; that the adult bee will come out through the burrow left by the parent; that the lower one comes out in its turn and so on, each finding a free passage made for it. Now the actual facts are almost the direct opposite. In the first place the parent bee digs down just as far as it intends to go—in one case over 40 inches—then sends off an oblique lateral and constructs a cell, which agrees fairly well with the published accounts. Having filled this cell the mother bee begins another lateral some 6 inches or more above the first, and uses the material excavated out of it to fill up the burrow below, thus saving herself the trouble of carting sand to the surface and at the same time closing completely the entrance to the cell below. When this second lateral has been loaded with a cell a third is started still nearer to the surface, and the second lateral is filled up. When the bee has completed as many laterals as she thinks it desirable to fill, she simply breaks the burrow down altogether, so nothing is visible except perhaps a discolored heap of sand at the surface, which is beaten down by the first heavy rain that comes. All the bees from these underground cells mature at about the same time and each one must, in order to reach the surface, dig through the layer of sand resting upon it, be it only 6 or as many as 40 inches.

Concerning other insects our knowledge has also been materially added to by this method of study, and it is one that adapts itself, particularly to lighter soils, where following a burrow in any other way becomes difficult or almost impossible. Ant hills offer more difficulties than any other kind of underground workings, and this for several reasons: the chambers are, first of all, so terribly irregular; they are often connected by very narrow passages; they are on different planes and two or three roads into or out of a chamber is nothing unusual. The galleries are also well populated, and a few specimens at one time in a narrow gallery will obstruct the flow of the plaster, particularly toward the end of the pour when setting is about ready to begin. Taking out a cast of that kind also offers innumerable difficulties and is an exercise in patience and perseverance. The results, however, are astonishing, and incomplete as the method is for this purpose, it yet gives us a much clearer conception of an ant hill than we can get in any other possible way.

To the entomologist's collecting outfit there must be added in the future a can of dental plaster, some graduates, a funnel or two, a good shovel, at least two trowels and two or three knives with flexible blades to dig around the casts without breaking them.

After the casts have been removed from the ground they must be thoroughly dried in order to harden them, and they can be then brushed clear of unnecessary sand and earth and preserved in any way desired for further reference and study.

Wireless Telegraphy Experiments at New York.

Signor Marconi has postponed his trip to this country until the fall and he may not come at all this year. Experiments are being conducted at Tompkinsville, Staten Island, by Mr. W. J. Clarke, under the inspection of Col. D. P. Heap, of the United States Lighthouse Depot at Tompkinsville, Staten Island. A pole 70 feet high has been erected at Tompkinsville, and signals have been sent to a lighthouse tender off Coney Island. The current was sufficient to ring an electric bell, but no messages have as yet been transmitted.

The Manufacture of Caviar.

Formerly caviar was all imported, but now it is made in considerable quantities in the United States. The weight of the roe is about 10 to 14 per cent of the sturgeon. The roe is taken from the fish, and thrown into tanks; it is then washed and rubbed through screens until the eggs are all separated. They are then packed in kegs with salt and kept cool until it is canned.

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Automobile News.

A large plant for the Daimler Manufacturing Company at Steinway, N. Y., is now under way.

There has been great difficulty in London in finding drivers for electric vehicles, and one company has dismissed its employes and closed up its plant on this account.

Arrangements are now being made for another motor carriage race in France. It will be run about the 15th of August, the course being from Malo to St. Omer and back via Calais. The distance is seventy-five miles.

In New York city there are 5,000 cabs that ply for hire. In Paris the cost of the current for the electric cabs is about 90 cents per day. If the 5,000 horse cabs in New York should all change to horseless cabs, the amount which they would pay for power would be of great assistance to the income of the central stations.

A New York bicyclist crashed into an automobile coming in the opposite direction. The bicyclist was thrown and broke his collar bone. Accidents of this nature, at the present time, are unfortunate, for no matter whether the wheelman or pedestrian is at fault, the automobile is sure to receive the blame for the accident.

A traction engine drawing three loads of furniture in Wales recently became unmanageable and dashed down a hill at a terrific speed. The furniture van was stopped by a large tree and collapsed, but the engine continued on its course, and after felling a large tree which stood in its path it turned over. One man was killed in the accident and two were injured. Traction engines have always been considered very safe and this is certainly an extraordinary accident.

Among the curiosities in the way of automobile fittings in Paris is the wheel of M. Izart. It really consists of two wheels; one the wheel proper of the vehicle and the other a loose wheel tire which is kept in place by lateral bars. It is claimed that this invention diminishes the friction by one-third and that the vibration is very much lessened by its use. It is also claimed that it will aid in driving carriages over ruts and over obstacles.

Attempts are being made in Berlin to introduce omnibuses which are propelled by electricity. One of the most interesting has been constructed by Siemens & Halske. It can run on the street railway tracks or on the ordinary pavement. It is provided with a collector which enables the accumulators to be charged from the overhead trolley wires during the journey over the tracks. It is calculated that this vehicle will have no difficulty in making eleven miles an hour and run several miles on one charge.

A correspondent recently visited the automobile show at Paris, and expressed himself as being very much astonished at the multiplicity of types exhibited by the manufacturers. He states that they are far behind their orders. Gasoline carriages seem to be the favorite for private owners in Paris. Small motor tricycles are very numerous and are quite noisy. The great speed of the gasoline carriage is particularly noticeable. They all use the horn as a signal of approach, and it is now as well known as the incessant snapping of the whip, at which the Paris "cocher" is an adept.

The German Minister of War recently stated that the military authorities were following the development of the automobile industry with the greatest attention and would do everything to further and make use of it. The appropriation for this purpose in the Military Budget was voted for unanimously. The general introduction of automobiles would increase the mobility of an army fourfold, especially in cases where the roads are such as to permit of rapid movement. Automobiles can be made use of as regimental baggage wagons and as ambulances for army postal service. In modern warfare the more the army can get rid of living creatures, man or beast, which are not combatants, and replace them by mechanical substitutes, the more confidently will a general take the field.

The "motor scout" was exhibited at the Automobile Club's recent show at Richmond, England. It consisted of a quadricycle fitted with a 1½ horse power petroleum motor. It is convertible, carrying either two persons or one person, and a light Maxim gun. The gun is mounted in front over the leading wheels, and it is arranged so that it can be fired with the vehicle going at full speed. Below there is a tray sufficient to store 1,000 rounds of ammunition. Another type is termed a "war motor car." According to The Mechanical Engineer, it is plated with armor and has a ram both in front and behind. The armament consists of two quick-firing Maxim guns carried in two revolving turrets. The steering is done by the aid of information obtained by mirrors so that the crew need not expose themselves. The car is driven by a four-cylinder Daimler motor developing 16 horse power. An electric search light is provided, the dynamo being worked by the main engine.

Engineering Notes.

Two separate railroads into the Grand Cañon of the Colorado are now assured. The preliminary surveys have been completed for one of the roads, and the line is being slowly located ahead of the graders.

The British government is now manufacturing a new bullet which is even more deadly than the dum-dum. The new projectile has a soft metal point which expands with the friction caused by flight. It is said that 200,000,000 rounds of the bullet are already in stock.

The last large gun of the battleship "Kearsarge" has reached the shipyard at Newport News, and now the main battery is complete. The smaller guns will not be put in position until after the trial trip, which is expected to take place soon. The guns of the secondary battery will probably be put on at the New York or Norfolk navy yard.

The first elevator was built in 1850, using worm gears. Owing to the low height of buildings, there was little demand for elevators until the localization of commerce filled the great centers of distribution with merchants and merchandise, so that story after story was added to buildings, necessitating the rapid development of the elevator. In the current SUPPLEMENT, the first installment of Charles R. Pratt's paper on "Elevators" is printed.

It was on the 22d of June, 1799, that the meter, the basis of the metric system, was decided upon by the Corps Legislatif, upon the report of French scientists. Consequently, the meter is one hundred years old, and we must admit it has made a remarkable progress in that period. At the same time there is great room for improvement in this respect, and it is to be hoped that by the time another century passes away it will be in universal use by every civilized country on the globe.

The total displacement of ships now under construction for the British navy amounts to no less than 488,000 tons. In the current number of the SUPPLEMENT there is a most impressive illustration showing in a group the vessels as they will appear when they are completed. There are six battleships of 12,950 tons; six battleships of 15,000 tons; six battleships of 14,000 tons; four armored cruisers of 14,100 tons, with a speed of 23 knots; six armored cruisers of 12,000 tons with a speed of 21 knots; and four armored cruisers of 9,800 tons with a speed of 23 knots, besides fourteen protected cruisers.

An important railway project, both from a commercial and political point of view, says The Nation, is the continuation of the Anatolian Railway from Angora to Bagdad. The necessary capital is to be furnished by the Germans. The country which will be opened up is rich in natural resources, and most of it was formerly densely populated. Russia naturally objects to this route, because it comes so near to the Russian sphere of influence, although two hundred miles from the frontier. There is little doubt, however, that much trade would be diverted from Russia to Germany, and German interest would become paramount in a region where Russia has been hitherto without a rival.

A navigable waterway from Birmingham to Mobile is under contemplation. The scheme was originated by Mayor Van Hoose, of Birmingham, Ala. Such a waterway would be a great thing for the iron and steel industries of the South. The plan is to put Birmingham in communication with Mobile by way of the Valley and Warrior Rivers at tide-water, in order that loaded barges may be taken direct from the wharves in Birmingham to the West Indies and other Southern ports. The last Congress appropriated $800,000 for the improvement of the Warrior River, putting in a system of locks and dams which makes it navigable to a point within fifty miles of Birmingham. It would require $6,000,000 to $8,000,000 to complete the job of extending the waterway to Birmingham.

Various devices have been used in Europe for the ventilation of tunnels. In some cases, oil-burning or electric locomotives have been substituted for the trip through the tunnel, and in other cases artificial ventilation has been used. In the St. Gothard tunnel, in Switzerland, an increasing number of trains has resulted in materially altering the conditions which existed when the tunnel was first built. Finally, the plan of M. Saccardo was adopted. This consists in forcing a volume of air at high speed into an annular chamber which encircles the whole circumference of the tunnel at one end. From this chamber the air escapes on the inside face of the tunnel, and it is either drawn out or forced in so as to produce an artificial current. The plant is installed at Goeschenan, at the northern end of the tunnel, and will act for the most part to push the air out from north to south in the ordinary direction of the natural draft. The ventilating machinery consists of two blowers revolving at a rate of seventy revolutions per minute. With their aid a current with a velocity of 2·8 meters per second is produced. Travelers over this beautiful and well managed road will appreciate the change.

Electrical Notes.

The Viege-Zermatt electric mountain road is to be extended from Stalden to Saas-Fée, a distance of ten miles. The rack system will be employed at all points where the grade exceeds twenty-five per cent.

The magnetic observations at the Vienna Observatory have had to be entirely discontinued on account of the bad effects of the electric tramways and electric light wires. The director of the observatory has submitted a plan to the government for a new observatory, to be situated some distance from Vienna.

Prof. F. B. Crocker, of Columbia University, conseders that the Japanese are very unsuccessful as electrical engineers. While labor is eight times as cheap, the product is proportionately poor. He states that the electrical studies are thoroughly up to date, the lectures being given in English or with a liberal use of English words.

Electricity is coming into very general use in Poland. It is being largely adopted in many factories, superseding rope and belt driving. Electric lighting of factories is also becoming general. Most of the important railway stations are lighted with electricity. The Germans have succeeded in getting the lion's share of contracts for electrical equipment.

Chicago is now planning to use the current of the drainage canal for lighting and other purposes. Where the stream discharges into the Desplaines River a dam is building. At this point a head of sixteen feet will be secured. Two routes have been under consideration. One called the central route has been adopted, and it is estimated that the enterprise will cost only $265,000 and 15,000 or 16,000 horse power will be realized with the present maximum flow which is available.

The Chairman of the Metropolitan Underground Railway of London has announced that at the beginning of October electric traction will be installed on the lines of the Company. All who have ever visited London know that this wonderful system of underground roads is not particularly pleasing to ride on, owing to the smoke and gas from the engines. The introduction of electricity will be a vast improvement and will undoubtedly tend to increase the business of the Company.

Further details of the destruction of the Como Silk and Electrical Exhibition have come to hand. Within thirty-five minutes from the time the first alarm was given, all the buildings were entirely destroyed. An attempt was made to use fire hose, but at first the pumps refused to work, and when they did get into working order the fire had become unmanageable. The immense boilers used for driving the dynamos exploded, and two air or gas tanks also blew up. The whole exhibition was valued at $2,500,000 and was utterly destroyed. No lives appear to have been lost but salvage operations were precluded by the rapid spreading of the flames. The only objects saved were a painting and Volta's sword of honor. Keen regret is expressed for the loss of the invaluable Volta records as well as the instruments.

The life of the champagne manufacturer is made miserable by the breakage in the cellars and the leakage of the gas from the bottles. A French scientist has devised a plan for obviating the latter difficulty which is simple, and if not too expensive it might be put into practical use with advantage. He covers the cork and the neck of the bottle with a layer of copper, deposited electrically. The bottle is coated with black lead or zinc powder and then placed in a bath and plated. After it has been coppered there will be no difficulty in plating on a copper base with either gold or silver. Probably champagne bottles would be the only bottles which could be treated in this way, owing to the expense; but if it could be cheapened, it would undoubtedly have many other uses.

Mechanism has been installed in one of the steeples of St. Patrick's Cathedral, of New York city, for ringing the chime of bells. There are nineteen bells, which vary in weight from 300 pounds to 7,000 pounds. The mechanism for striking the bells consists of a horizontal air cylinder connected to the tongue of each bell. The bells are hung around the belfry in two tiers, the larger ones being in the lower course. A system of steel I-beams is arranged to provide support for the operating cylinders. The cylinders for the large bells are 4⅜ inches in diameter, and they grade down to 2 inches in diameter. The bells have double clappers balancing each other. The piston rod of the air cylinder is attached to a central stud projecting below the center of the clapper. The piston is only used for a stroke one way, the weight of the clapper returning it. The air compressor is an 8×8 inch horizontal, double-acting, single-stage machine, making 150 rotations per minute, and is driven by an electric motor. The air is forced into an air reservoir, from which it is conveyed to the belfry through a 2-inch pipe, where there is another reservoir. The bells are operated by a keyboard which is in electrical connection with magnets controlling the valves of the air cylinders.

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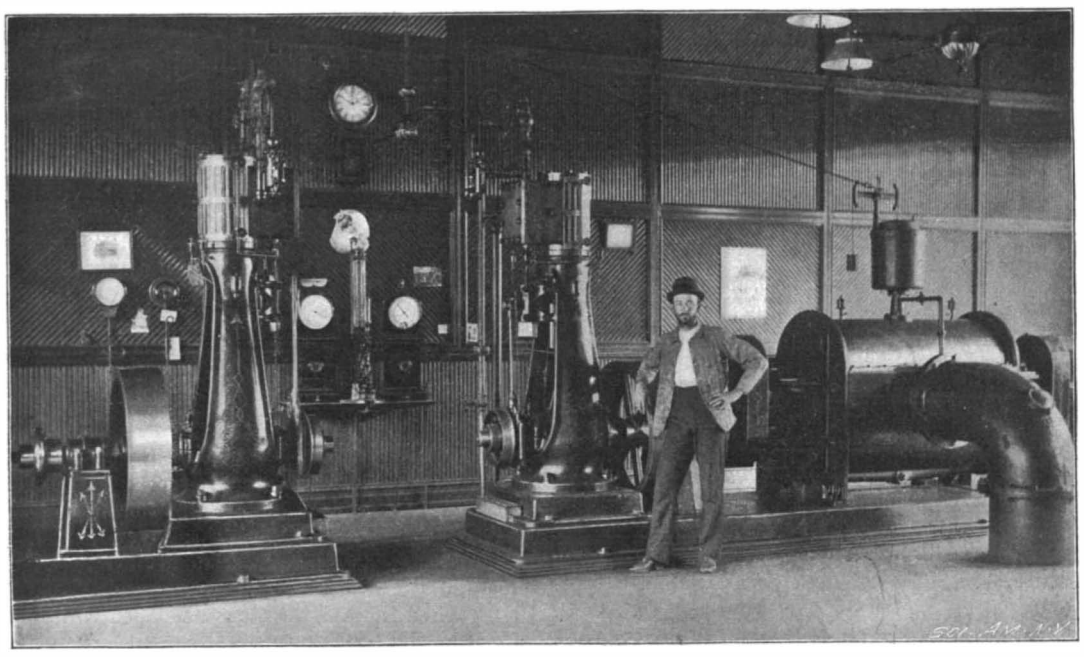
FUEL GAS.

BY C. FRANCIS JENKINS, E.E., M.E.

The enormous consumption of natural gas in the last decade has greatly advanced the demand for a fuel gas. Aside from its extensive use in factories and blast-furnaces, housewives, after coming to know the ease and cleanliness with which a gas fire can be started



EXHAUSTER ENGINES AND INDICATORS.

and maintained, find a coal stove or kitchen range a great hardship, and very reluctantly accept either, even when force of circumstances allow them no choice.

Similarly the different incandescent mantle burners, most efficient when using a gas which is high in heat units rather than in illuminants, are being received with wider and wider favor. With such a gas, the light is unquestionably the cheapest known, costing scarcely more than ¾ cent per 100-candle-power-hour, while tip burners require three or four times as much gas, with a corresponding increase in the amount of deleterious products of combustion. At first, and, in fact, until quite recently, these mantles were too liable to damage from insignificant jars. Knit of cotton in the well-known stocking-top form, afterward dipped in a solution of the oxides of the rare elements didymium, lanthanium, thorium and cerium, and burned to make them ready for use, they were very fragile. This trouble has now, however, in the best made mantles, been practically eliminated.

Another potent factor to be considered in connection with gas making is the gas engine. This motor, requiring a gas high in heat units, is daily coming into more common use on the score of economy and convenience, and in larger and larger units, although in America they are at present not so much in evidence as abroad. There are to-day in continental Europe more than a score of cities which operate their waterworks by means of gas engines, and at less than half the expense of well-operated steam-pumps.

It is, therefore, in the manufacture of gas, no longer a question of candle power alone, but the number of calories per cubic foot of gas produced. Of all the gases largely used by man, natural gas, or marsh gas, stands highest in heat units, and for gas engine work is almost ideal. Coal gas comes next, containing, as it does, a goodly portion, say 30 per cent, of marsh gas, with twice as much hydrogen. With carbon as a standard, the heat units of marsh gas are 2·53, pure hydrogen 4·25, coal gas 1·71, and water gas but 0·59.

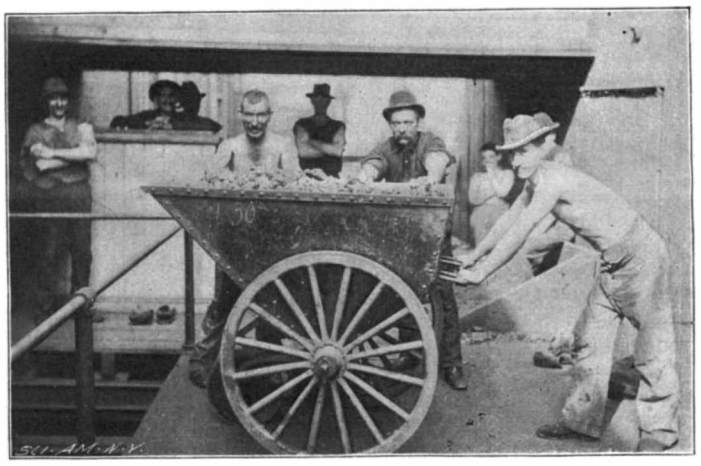
Now, although coal gas is high in heat units, water gas is a far better conveyor, and is usually mixed therewith in one way or another. Water gas, on the other hand, while low in heat units is high in illuminating power, but, unfortunately, cannot be raised to a sufficient temperature in a common gas tip to burn well alone. So the two gases have come very commonly to be combined in about the proportion of two parts of water gas, with a specific gravity of 0·7, to one part of coal gas, with a specific gravity of little more than half as much, say 0·45, with 0·6 as the specific gravity of the mixture.

But, notwithstanding coal gas is much the lighter, the vapor tension of the two when combined, although different from the vapor tension of either of them separately, entirely prevents the gases from stratifying in the holder or mains.

Although the mixture of the gases is here given as two to one, the proportion is controlled almost entirely by the exigencies of the case. In some cities a very high candle-power is demanded by the municipal authorities, while in others no attention is paid to the matter, the number of those who want heating gas and of those who want lighting gas being about averaged. Then, too, while coal in some localities is very cheap and the manufacture of coal gas would seem to be most economical, the making of water gas is more nearly automatic, requiring the employment of fewer workmen, thus reducing the margin of loss to the company by strikes and other labor troubles.

This leads naturally to a description of what might be called the new process gas, a process based upon the known fact that water (H_2O) in the presence of highly heated carbon (C) is decomposed, forming a new compound known as water gas ($4H+CO$). Though the plant is usually made up of several generators, it suffices to explain the construction and operation of a single one. The generator is a large sheet iron cylinder, lined inside with thick fire blocks, the top having an opening, say, fifteen inches in diameter, closable with a heavy lid, making a gas-tight joint. From near the top a pipe leads away, through the exhauster, to the holder, while near the bottom there are two intake pipes, one a blasting pipe from the pressure blower in the engine room, the other from a steam supply. With a fire in the bottom, the generator is filled with coal, or coke, and the blast turned on, which fans the entire charge of coal to incandescence. When the roaring column of blue flame coming from the blow-off has reached a certain fierceness and transparency, a laborer, working a lever, simultaneously closes the lid and shuts off the blast, at the same time opening the steam intake and the gas outlet. The steam coming into contact with the incandescent coal is decomposed, the oxygen taking up carbon and liberating hydrogen, the whole combining to form a gas. Although some substances gasify at as low a temperature as 40° Fah., others require as high as 150°, the intense heat of the generator, say 2,000° or more, causes all the substances to gasify at the same moment, and the whole passes off as a stable compound, piped, through the exhauster in the engine room, directly to the holder, where, as it enters, it is mixed with coal gas. Such a degree of exhaustion is maintained as to just relieve the generators of the weight of the holder (shown on indicators in the engine room). This process of charging, blasting, and steaming is repeated every few minutes, with no by-products.

The simple water-gas process requires few attendants, while the production of coal gas is accomplished at the expenditure of considerable manual labor. Briefly, coal gas is generated in coal or coke charged retorts heated to incandescence, but, unlike water gas, it cannot be carried direct to the holders, for it must first be freed of impurities. To begin with, then, the laborers wheel in coal from the bins in iron carts, from which the stokers charge the retorts. A number of these retorts, fitted with airtight iron doors, are arranged side by side and above each other in considerable banks. The retorts are heated and the inclosed coal gasified by burning under them in mammoth Bunsen burners and a system of flues surrounding the retorts, a portion of the purified gas mixed with air, the latter, as a feature of economy, having been previously heated with the off-heat of the retorts.



THE CHARGERS.

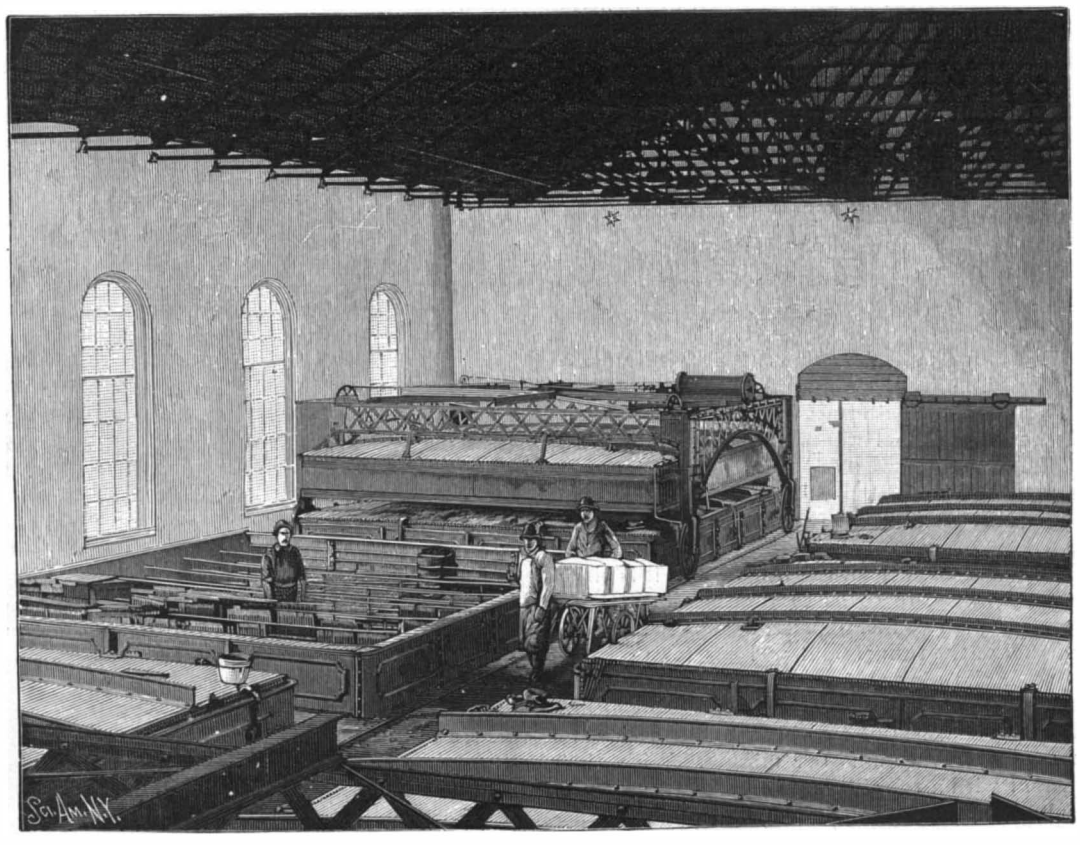
These retorts are made from a clay which, after burning, is composed of two parts silica and one part of aluminum, with scarcely a trace of iron or magnesia, which, with the great tenacity and elasticity necessary to withstand the strain of drawing and charging, are especially adapted to the high temperatures of present coal-gas practice.

From the retorts the gas is carried to the condensing and purifying houses, where by means of water-seal boxes containing lime and iron oxides, of scrubbers and other devices, it is deprived of tar and gas liquor. The scrubber takes out of the gas a large proportion of the carbon dioxide and all the ammonia, at the same time concentrating the latter into 20-ounce liquor.

The output of purified gas is about 10,000 cubic feet per ton of coal, in well operated ovens. The yield of water gas from a similar ton of soft coal in the generator is 55,000 cubic feet of 10 candle power gas. This can be enriched, however, with benzine or oil; the addition of 4 gallons of crude oil to 25 pounds of coal or coke producing 1,000 cubic feet of a 20 candle power gas.

However, any kind of gas between the two extremes of high heat and low illumination and low heat and high illumination can be obtained by a proper manipulation of the proportions of water gas and coal gas without this enriching process.

So, following the natural law of supply and demand, the manufacture of gas is slowly but surely undergoing a change adapting it to wider uses and greater consumption.



PURIFIERS.

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New Privileges for the Canadian Niagara Power Company.

A most important announcement in connection with the Niagara power development was made by Secretary William B. Rankine, of the Canadian Niagara Power Company, on Saturday, July 22. It is to the effect that on July 15, an amendatory agreement was executed between the commissioners of the Queen Victoria Niagara Falls Free Park, acting in the matter for the government of the Province of Ontario, and the Canadian Niagara Power Company, under the terms of which the Canadian Niagara Power Company is given until July 1, 1903, to develop 10,000 horse power in the Canadian park. Tho new franchise is for 110 years, and the rent has been reduced from $25,000 to $15,000 per annum. There are also other amendments in regard to the location of the plant and the power house, all the plans for which have been approved. The company on its part has yielded its exclusive right to the use of waters within the Canadian park, and therefore the commissioners of the park are at liberty to deal with other companies for the development of power outside the territory occupied by the Canadian Niagara Power Company. This agreement was authorized by an act of parliament passed in March last.

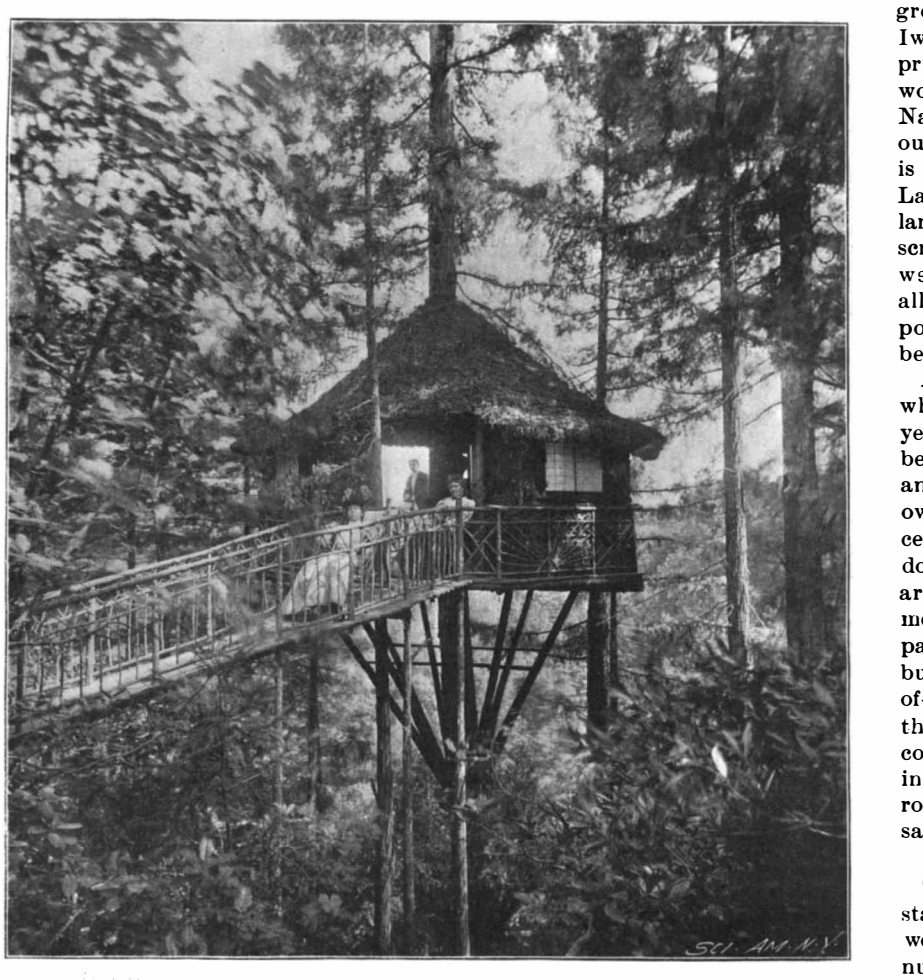
The Canadian Niagara Power Company is closely allied to the Niagara Falls Power Company. It is understood that the new franchise is far more satisfactory to the power company than the original one was, and it looks as though an exclusive right to develop power on the Canadian side was not now deemed as valuable as in 1892, when the original agreement was made. Under the provisions of that agreement the Canadian Niagara Power Company was to pay $25,000 a year rental for ten years, after which time the rent was to increase $1,000 per annum until it reached $35,000, and at this it was to remain during the life of the agreement, which might have been extended eighty years, making its total life a century. The company was also to have 10,000 developed horse power by November 1, 1898, and water connections made for 25,000 horse power. Under the new agreement they are given four years more to develop 10,000 horse power, and the rent is reduced to $15,000 a year.

TREE DWELLING IN CALIFORNIA.

Mill Valley is a suburban hamlet near San Francisco and lies at the foot of Mt. Tamalpais, the most prominent elevation on the bay shore and overlooking an extended prospect. It is the home of many of the wealthiest of San Francisco merchants, who here escape the fogs and dust of the city and find in genial surroundings that relaxation which is required after protracted attention to business. A little stream flows through the precipitous valley, which formerly nourished extensive groves of gigantic redwoods. Many of these great trees have escaped destruction at the woodman's hands and remain to form a most effective and attractive feature of the lovely landscape.

Art has been combined with nature most cheerfully. All the necessities of metropolitan life are afforded the dwellers without destroying the primitive charms which have always existed. A friendly rivalry exists among the people as to which shall exhibit the greatest novelty in the architecture of their homes. In no community of its size is there a greater display of eccentricity in this respect manifested. The spurs of the mountains are all adorned by houses of the most peculiar outward appearance, and with interiors which exhibit a rich display of taste and extreme comfort.

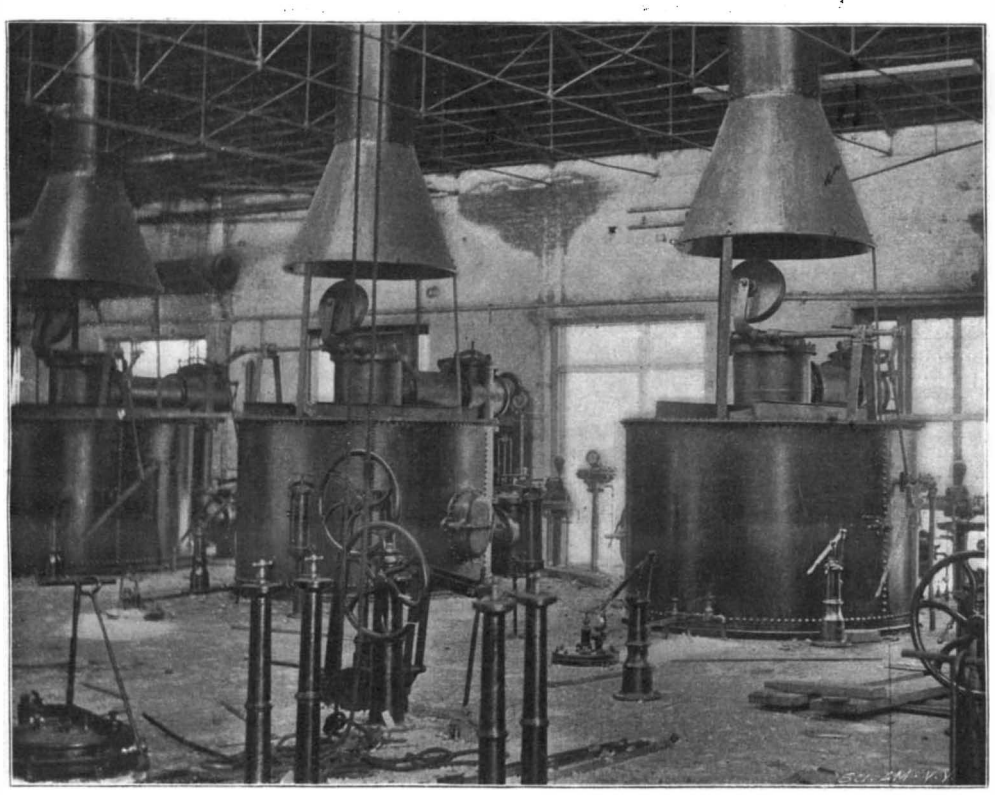
The illustration shows one home that has lately been constructed and is regarded as by far the most novel in the valley. It is built around a redwood tree and its floor is 50 feet above the ground. It has four rooms, and communicates with the bluff by a balcony of substantial construction. It is a charming conception and the abode of infinite comfort. There are no destructive beasts of prey or serpents of any kind to escape from in this peaceful valley, and the wild natives that once made this one of their favorite haunts have long ago migrated to the happy hunting grounds of their ancestors. The suggestion is the fruit of a search for novelty, and in that respect this dwelling surpasses all its neighbors.



A NOVEL TREE HOUSE IN CALIFORNIA.

Rail Exports.

The American mail brings some interesting information supplementary to that already cabled over, bearing upon the contract for 180,000 tons of steel rails which has been secured by the Carnegie Company to the order of the Russian government. It is common knowledge that the Russians had been endeavoring for several months to place this huge order, and that to secure the best possible terms they had been trying to play off the English and German makers against the American, and vice versa. At the end of last year the agent was sent to the United States, when rails were selling at $16 per ton, but he failed to close the deal. His government hoped to do better by waiting, and for an excuse there was some objection to certain details in the manufacturing process. He was sent back to England, and found on arrival that prices in this country had risen 5 shillings above the American. Rather than pay the equivalent of $17 per ton, the Russian government agreed to waive its former objection, and, according to the advices, the agent cabled over to America renewing the bid, only to find, however, that quotations were by this time $20 per ton. So he was sent off to Germany in the hope of getting a better bargain. There he found more trouble in the shape of a further advance to $23 a ton, with no assurance of early delivery. Then the cable was resorted to again; but by that time the steel mills of the world were so busy that no one in either America or Europe would accept the contract at $25 (which was then offered) for delivery within the time required. At last, however, after eight months of wavering, the order was placed at $26—an advance of about $10 a ton, which means an increased cost of $1,800,000 to Russia. This huge contract will make itself felt in many directions. "It is expected, for one thing," we are told, "to keep up the price of pig iron for the next two years. The Carnegie Company's competitors confidently hope that it will keep their big rival so busy during that time that it will be obliged to turn away business, which will then fall to them." There is an element of humor in this theory of how Russia was made to "pay through the nose" for its endeavor to be smart, but probably Russia itself will not see the funny side of the business in view of the extra cost. The triumph to America is very considerable, notwithstanding the evidence that is afforded of a disinclination on the part of English manufacturers to worry over the securing of the order; and it draws attention incidentally to the fact that our own foreign trade in rails is not progressing, as a result in a large measure, no doubt, of the advance of our very energetic rivals in the United States. Whatever may be the case with some other branches of engineering production, there seems no reason for doubt that in more than one market which might be named, we are suffering by the advance of the Americans. This much in relation to Japan, for example, was shown in the recently published report of our consul at Yokohama. Probably the differential rates of the conference steamers have something to do with the greater cheapness of the American article, but whatever the full explanation, the fact is there to be faced. Our own trade returns afford conclusive evidence that we are not doing extraordinary things in foreign markets in this respect. For last year our exports of "railroad iron of all sorts" were 610,213 tons, against 747,662 tons for 1896, 558,375 tons for 1893, and 1,035,431 tons for 1890. It is true that the 1898 total is in excess of any of the four years 1892-95 inclusive, but we do not base our rate of progress altogether on comparisons with a lean series of years any more than on comparisons with a fat series. The fact is that in the last two years we have gone back considerably, and the decline in the takings of Japan, Mexico, Indian, and other markets is referable to American progress.—London Engineering.



TOPS OF THE GENERATORS.

Ship Yards and Docks in Japan.

We have received a most interesting letter from Mr. P. J. McCormick, engineer at Yokohama, Japan, which gives us considerable information regarding the progress of important works in Japan. Baron Iwasaki, in Tokio, is the owner of the principal engineering and shipbuilding works in Japan, which are situated at Nagasaki. The two dry docks are cut out of soft rock, and in addition there is a large shipbuilding yard alongside. Last year this concern turned out several large ships, one being a 6,000-ton twin-screw steamer. The engines and boilers were built at the works, where they have all the best modern machinery and powerful cranes. At Kobe a dry dock is being built in sand at enormous expense.

At Yokohama there is also a dock which was cut out of soft rock about a year ago, and now another dock has just been finished alongside. A large engine and boiler shop are annexed, and all are owned by the same shipbuilding concern. There are a number of other large docks scattered around Japan, and all are owned by Japanese. The government has a number of docks, but no particulars as to their size are obtainable, but a short time ago a large English man-of-war was successfully docked at one of the government docks. The method of construction of most of them is interesting. They are nearly all cut out of soft rock, which can be cut with a pick the same as a piece of chalk.

THE Health Board of New York city states that in the last quarter there were 16,713, deaths, and that of this number four had reached the age of one hundred years or over.

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History of Bells.

Bells are of peculiar interest to almost every one. Their voices to some tell only of daily duty, of trains to catch, of the return of hours of toil, of the ceaseless flight of time: and to others they speak of devotion, and to others still bells are instruments of heart-stirring music. Recent years have seen the publication of not a few books upon the subject; the last newcomer is entitled "A Book About Bells," and is written by the Rev. George S. Tyack, and published in London by William Andrews & Company, from which we glean the following information regarding the history of bells:

There can be little question that the earliest musical instruments were those of percussion. There are frequent mention of bells in the Old Testament, and among Oriental nations bells, or at least tuned pieces of metal, occupy a large part of attention among native musicians, not only in the past, but even at the present time. This primitive and well-spread discovery of tones producible by blows on resonant substances being thus granted, it may readily be seen that something more or less resembling the modern bell in shape would almost certainly be a very early invention. The Book of Exodus gave probably the earliest mention of bells in its illusion to six golden ones which tinkled around the vestments of Levitical High Priest. There is another reason for them in the words of the prophet Zachariah, who speaks of the harness of horses being adorned with them. Turning from sacred to profane literature, we find small bells spoken of by Euripides and by Aristophanes. Plutarch refers to them in his Life of Brutus and Virgil in his Georgics.

The researches of antiquarians have brought to light facts which indisputably prove the early use of bells. Bronze and iron bells were found by Layard in his excavations of Nimroud and very ancient examples have been met with in various places in the far East; while turning to the far West we have instances of copper bells found in ancient Peruvian tombs. Curiously enough there appears to be no proof that bells were used at all in Egypt. There is no trustworthy evidence of the use of really large bells before the dawn of Christianity, and they owe their existence to Christian influences. The credit of the invention has been given to Paulinus, Bishop of Nola in Campania. Paulinus lived about 400 A. D., but it is claimed the distinction is doubtful and a better title for it is made up for Pope Sabianus, who succeeded St. Gregory in the papal chair 604. In any case, from about that date notices of the use of bells, which must have been more or less of the kind and size now seen in turrets, become frequent. By the year 750 in England the church bell became sufficiently common for orders to be issued to have the priests to toll them at an appointed hour. Literature, and specially poetry, illustrate in a striking way the place which bells have for ages filled in the lives of men.

The earliest bells were probably not cast, but were made of metal plates riveted together. One set, which belonged to St. Gall, A. D. 650, is still preserved at St. Gall, Switzerland, and another one, traditionally associated with St. Patrick, is shown at Belfast. These are made of iron, and are only about six inches high.

Other early examples may also be cited. Bells of this kind are not round, but wedge-shaped, being broad and square at the mouth and rising to a ridge at the top. The names of no very early bell founders have come down to us, and probably the bell founder's art, like others which were exercised chiefly for the furnishing and adornment of the church, was originally practiced almost exclusively by the ecclesiastics themselves. As churches and monastic houses increased in number, naturally the art of bell founding drifted into the hands of a professional class and scattered records of some of its members have come down to our time. The chief centers of the art in England were at York, Gloucester, London, and Nottingham. It is probable that many of the early bell founders had no fixed place for working, but traveled through the country, rearing temporary foundries at various convenient places, and casting there such bells as might be wanted throughout the neighboring districts. In many cases it is certain that the bell founder did not devote himself exclusively to that work, but combined with it some other more or less analogous trade. Often the itinerant bell founders cast their bells directly at or in the churches, for doubtless the conditions of the country in early times made the transport of heavy masses of metal a matter of no little difficulty, so that the founders were glad to work as near as possible to the towers to which the bells were to be raised. In 1483 the importation of foreign bells into England was made illegal, a fact which would imply that the bells at that time were brought into the country in sufficient numbers to affect the home industry. On the Continent Louvain was the seat of a famous bell foundry. Deventer, Holland, was another center of the industry. The French bells were made of iron, while brass was commonly employed in Italy and England, and a foundry in Bohemia has recently turned out bells of steel, but the experiment can only be called fairly satisfactory at best. A church in Scotland has a bell of this metal cast in 1895 by the Vickers, of Sheffield, who have also cast steel bells for a church in Hastings and other places. Glass has been employed for bells of fair size, but the tones of such bells are sweet but not far-reaching. Even wood has been used as a material in bell manufacturing, but the wooden bells which have been found may possibly have only served as patterns for the maker of the bell-frame or for some such purpose.

Bell metal consists of a compound of copper and tin, usually three parts of copper to one of tin in small bells, and four parts of copper to one of tin in large bells. If the amount of tin be increased the bell becomes more brittle, but if the copper be in excess the brilliancy of its tone is damaged. Sometimes small quantities of zinc and iron are added. It is a popular superstition that a bell of specially sweet tone owes its excellence to the presence of a quantity of silver in its composition, but it is asserted by experts that the employment of silver would have precisely the contrary effect on the tone of the bell to that which tradition assigns to it, silver being in its nature too closely allied to lead to permit of use in this case. No less important to the voice of a bell and its material is its shape. Medieval bells were for the most part longer and narrower than those of more modern make. In practice it is found if the bell be too flat the vibrations expel the air from within with an almost explosive force and the sound is loud and harsh. If, however, the opposite error be committed and the height be too great in proportion to the diameter, the air reverberates too much within the bell itself and the sound does not travel satisfactorily.

In casting a church bell the first important work is the construction of the core, which usually consists of a hollow cone of brick erected on a cast iron plate as a foundation, and in diameter somewhat smaller than the interior of the bell. Over this is plastered a specially prepared mixture of clay, intended to bring up the core to the exact size and shape of this interior. The core is baked dry and hard by means of a fire within it. Over this is built up what is called a "thickness," by which name the founders call a second layer of clay of exactly the thickness, shape, and size of the proposed bell. This gives the correct figure of the outside of the bell. This is then dusted over with dry tan, and upon this is constructed the "cope," or outer casing of clay several inches thick. After the cope has become thoroughly dry by means of fire, it is raised with the help of a crane, and the clay which formed the "thickness" is destroyed. The cope is then lowered into its former position, care being taken to make it concentric with the core, then the mold is ready to cast. Where quantities of bells are produced the "thickness" is done away with and a cast iron cope case is substituted. Every part of the bell has a technical name. The hooks for fastening the bell to the wooden stock, which forms the axle on which it revolves in the belfry, are called the "cannons." The loop from which to suspend the clapper has also to be cast. In many modern bells the cannons are dispensed with and the bell is bolted directly on to its stock. This has the advantage of enabling the bell to be turned. The clapper is technically divided into ball or hammer, and the flight or shaft, which is fastened directly into the crown of the bell by an iron staple.

Most ancient and many modern bells bear some motto or device, to which the modern makers add the date and the name of the firm. These, of course, must be impressed in the cope before casting.

In ancient days when the art of bell casting was still retained in the hands of the ecclesiastics, the furnace and the castings were blessed, which must have been a picturesque scene. It usually takes seven or eight hours to heat the metal and it does not take as many minutes to run it into the cope even where the bell is a large one. Then follows a time of keen anxiety in the foundry, specially if the work be one of unusual size and importance. Six days are usually allowed to elapse before the metal is touched. The bell is then put in a temporary frame to undergo the ordeal of testing the tone. It is then carefully finished and tuned. If the notes struck out be too flat a portion of the edge of the bell is cut away, thus reducing the diameter. If it be too sharp, the thickness of the sound-bow is reduced. Nowadays the bell is turned in a specially designed lathe, the bell being secured to the face plate, and the requisite amount of metal can be cut away with the greatest accuracy. Where the bell is to form a part of a chime, it must be tuned so as to accord with the others. The reception and erection of a large bell is frequently the cause of great ceremonies and rejoicing specially where the bell is for a church.

Many of the bells have decorations and inscriptions on them which are very curious. Of this kind was the legend of "Mighty Tom," of Oxford, before its recasting in 1612. The translation of the Latin inscription would be:

"For Thomas' sake
I cry Bim Bom, and nó mistake."

Sometimes where there was a chime each bell had a separate legend. A good deal of the poetry is really doggerel as:

"On Sabbath all
To church I call."

Another one:

"The sleepy head I raise from bed."

Inscriptions were found on some of the seventeenth century bells. Among them one in Addington, 1658:

"When you hear this mournful sound
Prepare yourself for underground."

The following lines are met with in a great many places in the different countries:

"I to the church the living call
And to the grave do summon all."

All the bells do not have such lugubrious inscriptions. Sometimes the inscriptions refer to a wedding.

"When men in Hymen's bond unite
Our merry peals produce delight."

At times it is used for secular purposes, resulting in the appropriate inscriptions, as

"Lord quench this furious flame,
Arise, run, help put out the same."

The church of St. Ives has a bell which has the following terse inscription:

"Arise and go about your business."

In addition to the various mottoes, etc., to which we have referred, in many cases we find on the bells the record of ecclesiastical rulers of the parish at the time of their casting which have been of great value to the historian. At Clapham, Bedfordshire, there is a bell in which one word of the inscription is upside down. It reads "God Save the Church," and the word "church" is upside down.

"COLUMBIA" AND "SHAMROCK"—A COMPARISON.

Now that "Shamrock," the sixth British cutter to cross the Atlantic in quest of the "America" cup since 1885, is well on her way over the Western Ocean, it will be of interest to compare her sailing qualities with those of the boat which is certain to be chosen for the defense. "Genesta," "Galatea," "Thistle," "Valkyrie II." and "Valkyrie III."—it is a right royal line with which this Anglo-Scotch-Irish craft is associated in holding her title of challenger; and with her Irish name, Scotch design, and English construction, she is truly representative of the people to whose fostering care the early growth of the sport of yacht sailing and its present popularity are largely due.

We have already pointed out, in former notices of "Columbia" and "Shamrock," that in the dimensions and construction of their hulls there is great similarity between the two boats. "Columbia," though stronger than "Defender," is yet a remarkably light craft, and in "Shamrock" Thornycroft, with his quarter of a century's experience in torpedo-boat building, has produced a hull and spars that are probably an advance over the American boat in the matter of light scantling and up-to-the-limit construction. The continued secrecy as to "Shamrock's" under-water body is no doubt due to a wish to conceal her excessive draught, and it is not unlikely that she will be found to draw as much as 22 feet. This would mean lower lead, less of it, and a nearer approach to the true fin keel than has been shown in any 90-foot yacht since the construction of our own "Pilgrim" in 1893.

As will be readily seen by a study of the beam views of the two vessels there are notable differences in their sail plans. "Shamrock's" mast appears to be stepped about 2 feet further aft than "Columbia's," and her bowsprit is considerably longer, the distance from mast to outer end of bowsprit being from 5 to 7 feet greater in "Shamrock." Her present boom is about the same length as "Columbia's." The gaff, topmast, and hoist of mainsail, on the other hand, are a few feet less than "Columbia's," so that the sail plan is longer on the base line but not so lofty as that of the American boat. She probably carries a larger spinnaker, larger head sails, and a smaller mainsail, the effect of which, other things being equal, should be to give "Columbia" the advantage in windward work and "Shamrock" in reaching and running. Her owner, Sir Thomas Lipton, and her designer, Fife, have both stated that she is to carry a larger mainsail in the races on this side.

A fairly reliable comparison of the sailing qualities of the two boats is obtained by studying the remarkable series of races sailed by "Britannia" and "Vigilant" in 1894, and comparing the results with the performance in America of "Vigilant" against "Defender," in 1895, and "Defender" against "Columbia," in 1899, and with the recent trials in England of "Britannia" against "Shamrock." Of course the value of such comparisons depends upon the boats "Vigilant" and "Britannia" being as fast in subsequent years as they were in 1894. There is no doubt that they were in as good condition, and possibly better. "Vigilant" was improved in 1895 by the removal of 43,000 pounds of lead from the inside and the addition of 53,000 pounds to the outside of the keel, and "Britannia," in addition to the improvements in trim, sail-plan, etc., due to three years of continuous racing, was recoppered, her topsides replaned and carefully smoothed off, and her wooden boom was replaced by one of steel, before she raced "Shamrock."

The "Vigilant" and "Britannia" sailed seventeen races, of which "Britannia" won eleven and "Vigilant" six. This would appear to denote a decided

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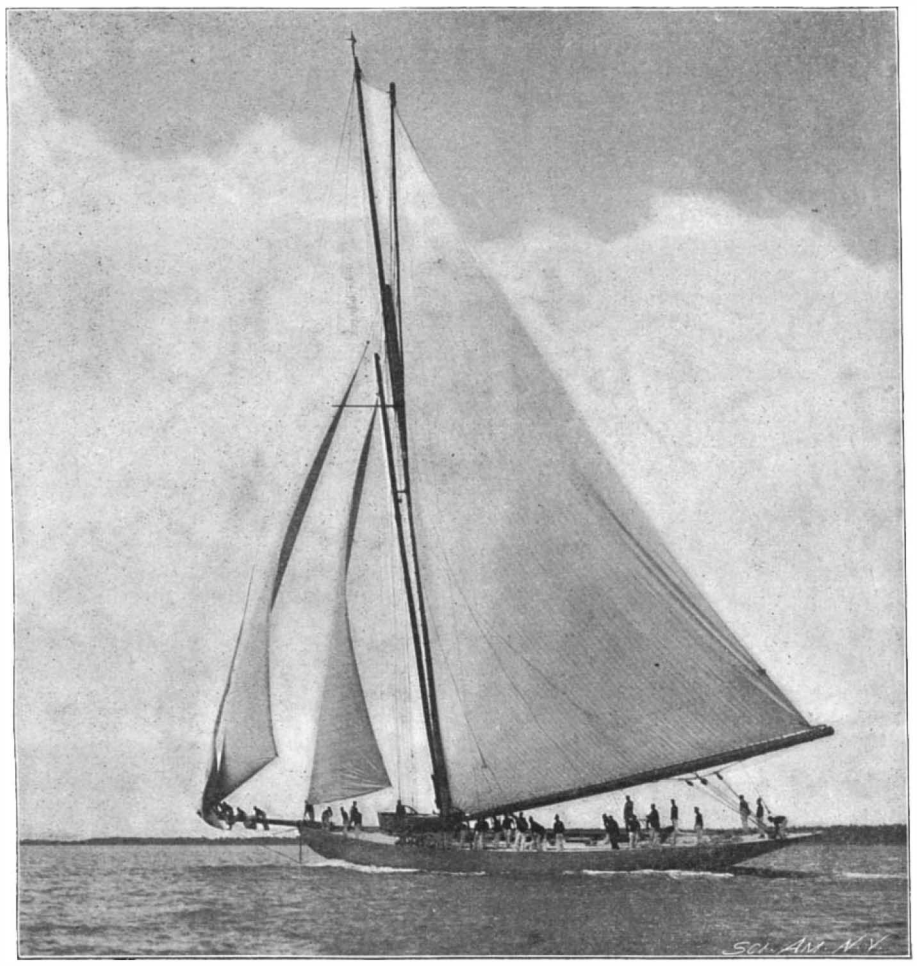
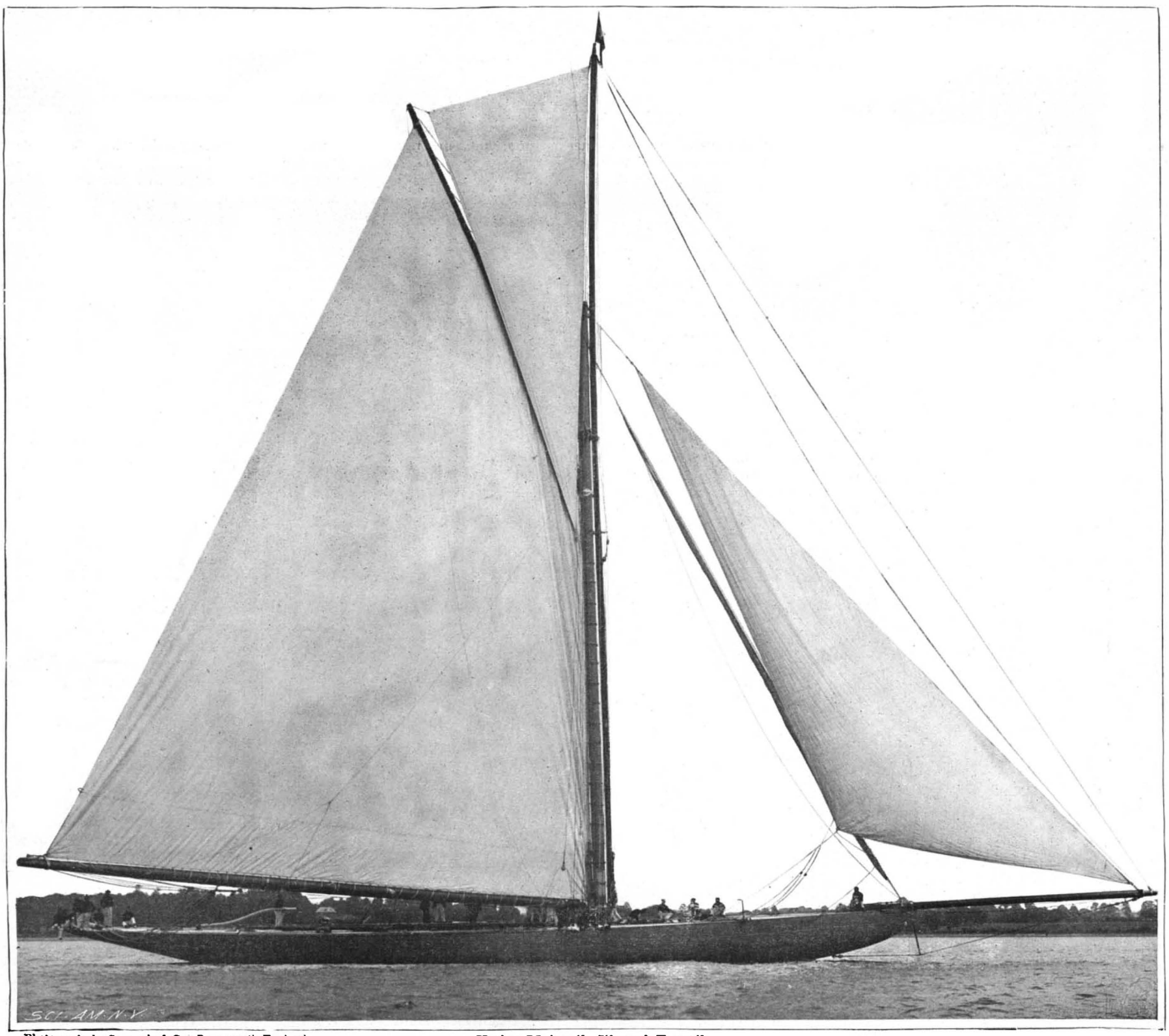
superiority in "Britannia," and in winds of a certain strength she was superior. In races sailed at an average speed of 8 knots an hour or less, "Britannia" usually won, and her wins were larger the lighter the wind; but when the average speed exceeded 8 knots an hour, it was "Vigilant's" day, and the harder it blew, the greater was her margin of winning. Dixon Kemp, the well-known English yachting expert, summing up the season's work, pronounced the boats about equal. That the verdict is a just one is shown by the following results. On a 50-mile course sailed at an average speed of 8·3 knots in a fine whole-sail



Reaching.

Close-hauled.



Under Mainsail, Jib and Topsail.

Photographs by Symonds & Co., Portsmouth, England.

THREE VIEWS OF THE CHALLENGING YACHT "SHAMROCK."

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breeze. "Britannia" won by 35 seconds; but over the same course, with a lighter wind, sailing at an average speed of 6·3 knots, she won by 5 minutes 52 seconds. In another 50-mile race sailed at 6·4 knots speed, however, "Vigilant" won by 3 minutes 52 seconds. In a strong breeze, the "Vigilant," sailing at a speed of 9·6 knots, beat "Britannia" by 4 minutes 32 seconds over a 50-mile course, which would be equivalent to 2 minutes 43 seconds on a 30-mile course. Then "Britannia" wins a 50-mile race by 22 seconds, sailing at an average speed of 8·7 knots. "Vigilant's" best win was at the rate of 4 minutes over a 30-mile course, the average speed being 11·2 knots in a strong wind. Other wins of "Britannia" were by 1 minute 27 seconds, 2 minutes 14 seconds, and 2 minutes 4 seconds over 50-mile courses. The results bear out the statement of Dixon Kemp that in the "give and take" of yachting weather the boats are very evenly matched.

In comparing "Shamrock" and "Columbia" through these two boats, we shall take the actual times made over specified distances on the different points of sailing, namely, beating, reaching, and running; and we shall consider only official races, in which the distances and times were accurately known and taken by a sailing committee. Records of informal "brushes" are quite unreliable both as to distance and time.

I. BEATING.—In "Shamrock's" first race, according to the English Yachtsman, "Britannia" started well ahead of "Shamrock," but was worsted by 6 minutes 13 seconds in a beat of 8 knots dead to windward, the distance being covered in about one hour. "Shamrock," owing to an accident to her club-topsail, carried only the jib-headed topsail, shown in our photographs, which were taken during the progress of this race. The "Britannia" carried her large club topsail, and we may reasonably suppose that with her own club-topsail set, "Shamrock" would have gained fully 6 minutes 30 seconds in the 8 miles.

In a race 15 miles to windward and return over the Sandy Hook course this would mean a gain of 12 minutes 10 seconds over "Britannia" in the beat to windward. Now, in beating twice over a stretch of 7 miles to windward during a race sailed on the Clyde at an average speed of about 8·3 knots, "Vigilant" gained 2 seconds on the first round and "Britannia" 7 seconds on the second round; and in other work to windward in races sailed at the same speed as the first "Shamrock"-"Britannia" race, "Vigilant" and "Britannia" were approximately equal. This would show "Shamrock" to be about 12 minutes 10 seconds faster in 15 miles windward work than "Vigilant." In the "Defender"-"Vigilant" trial races off Sandy Hook "Defender" gained on "Vigilant" 6 minutes 33 seconds on a 10-mile beat to windward. This would amount to 9 minutes 50 seconds in 15 miles, the speed of the "Defender" being 7·3 knots per hour measured dead to windward, while the speed of the "Shamrock" to windward in her race with "Britannia" was 7·8 knots. In the recent Sandy Hook trial race "Columbia" beat "Defender" 2 minutes 25 seconds in 10 miles to windward at a speed of 6·1 knots. This would amount to 3 minutes 37 seconds gain in 15 miles, or if sailed at the speed of the "Shamrock"-"Britannia" race the gain would be, say, about 3 minutes 30 seconds in 15 miles to windward.

This makes "Columbia" 13 minutes 20 seconds faster than "Vigilant" or "Britannia" in 15 miles to windward at a 7·8-knot speed, and 1 minute 10 seconds faster than "Shamrock" over the same course under the same conditions.

II. RUNNING.—Now, with the "Columbia" over 1 minute ahead at the weather mark, what would be "Shamrock's" chances of winning out in the 15-mile run to the finish? In the "Vigilant"-"Britannia" races "Britannia" showed a slight superiority in running. In the Clyde race, at an average speed of 8·6 knots, she gained 45 seconds on an 11-mile run; again, in a fresh club-topsail breeze, she gained 2 minutes on a 4-mile run, though on a second run of 4 miles the boats were even. In a strong westerly wind, although "Vigilant" won by 5 minutes over the whole course, the boats took the same time to run 5 miles; and in a race at 8 knots average speed "Britannia" gained 45 seconds on a 3½-mile run. We may fairly consider "Britannia" to be at least equal to "Vigilant" when running before the wind.

Now in the Sandy Hook trials "Vigilant" took 1 minute 33 seconds less than "Defender" to run 10 miles, a gain of 2·20 seconds in 15 miles. This was in a race whose average speed was 9 knots; but in an earlier race "Defender" beat "Vigilant" by 41 seconds in a run of the same distance. A consideration of all their races would show "Vigilant" to be faster on the average than "Defender" in a 15-mile run by about 1 minute and 30 seconds.

"Columbia" and "Defender" have had but few trials with their spinnakers spread. At Larchmont, in two runs over a 3-mile leg, there was in each run only from two to five seconds difference between the yachts, and the various trials show that "Columbia" is on the average about 30 seconds faster than "Defender" in 15 miles on this point of sailing. This would indicate that "Britannia" and "Vigilant" are about 1 minute faster than "Columbia" in a 15-mile run to leeward with spinnakers set.

"Shamrock" gained only 2 minutes 30 seconds on a 15-mile run with "Britannia," the speed being about the same as that in the various races above mentioned. Had she carried her club topsail and not split her spinnaker, she would have beaten "Britannia" by about 2 minutes 45 seconds. This suggests that "Shamrock" is about 3 minutes 45 seconds faster than "Columbia" on a 15-mile run; but the fact that in any race the last boat in a run before the wind has the advantage of a clear wind makes all such estimates of comparative running ability less reliable than estimates of work to windward. However, on the results as found, we see that judged by their actual performances in winds of similar strength, "Shamrock" should win a 30-mile race to windward and return by about 2½ minutes.

III. REACHING.—"Columbia" should win easily on a triangular course, which is made up of 30 miles of reaching or 20 miles of reaching and 10 miles of windward work.

"Vigilant" was superior to "Britannia" in reaching if the breeze was at all fresh. She gained on one occasion 2 minutes in a 10 mile reach, or say 4 minutes on 20 miles. In a broad reach of 61 miles, sailed at the high speed of over 13 knots, "Defender" gained 3 minutes 30 seconds on "Vigilant" or 1 minute 10 seconds on 20 miles. At the 9·2-knot speed of the "Shamrock"-"Britannia" race this would have amounted to about 1 minute 30 seconds on 20 miles, which added to "Vigilant's" gain of 4 minutes over "Britannia" shows "Defender" to have an advantage of 5 minutes and 30 seconds on 20 miles of reaching.

"Columbia" has not shown, so far, much superiority to "Defender" in reaching. She gained 1 minute 33 seconds on a 10-mile reach at Sandy Hook at a 10½-knot speed; but "Defender" at Larchmont was faster by 1 minute 7 seconds and again by 1 minute 40 seconds on a 10-mile reach. "Defender," however, was better handled, and perhaps it would be safe to say "Columbia" is 30 seconds faster in 20 miles of reaching in her present condition. This would show the cup defender to be 6 minutes faster than "Britannia" in the two 10-mile legs of reaching on a 30-mile course.

Now "Shamrock" appears to have proved a disappointment in reaching during her first race, gaining on "Britannia" only at a rate equivalent to 1 minute in 20 miles of broad reaching. If the triangular course contains 20 miles of reaching and 10 miles of windward work, we see that "Columbia" would gain 6—1=5 minutes in reaching and about 45 seconds to windward, winning the race by something under 6 minutes.

Summing up then, we find that a comparison of the yachts on their actual timed performances in official races, where the speed is over 8 knots an hour, "Shamrock" shows a slight advantage over a windward and leeward course, and "Columbia" a decided superiority over a triangular course. So much for work in a fine club-topsail breeze. Unfortunately the work of "Shamrock" in a light wind during a second race was not carefully timed. She appears to have gained about a quarter of an hour over half of a 36-mile course, and Lipton and his captains estimate that she would have gained 30 minutes if "Britannia" had finished the race. We have seen that "Britannia" did her best work against "Vigilant" in light airs, especially to windward, and it was in this very work that "Shamrock" appears to have walked away from the Prince of Wales' cutter. In the absence of reliable figures, we have attempted no estimate of the relative speed of "Columbia" and "Shamrock" in light winds; but the indications are that the security of the "America" cup will be enhanced by the prevalence of strong and steady breezes during the first week of October.

In conclusion it may be said that the above estimates may be entirely upset by the changes in sail-plan, trim, etc., in either or both yachts before the trials take place. When they cross the line on October 3 "Columbia" will have had three months to "tune up" to racing condition, and the improvements in speed which result from lengthy trials against "Defender" should easily reverse the slight advantage which "Shamrock" at present seems to possess on a windward and leeward course. The races will not be much closer this year than before; and the home boat will probably win out by the usual comfortable margin—a conviction which to our mind is strengthened by the fact that since the above was written Watson's "Meteor"—an improved "Valkyrie III."—has beaten "Britannia" by greater margins than "Shamrock" accomplished.

THE hydraulic mining pits in California materially changed the landscape in many places. The Mining and Scientific Press recently had an interesting illustration of the pit of a hydraulic mine in Nevada County, California, which was washed out some fifty years ago, and now it is again covered with a growth of pines and other trees, and patches of brush again dot the once verdureless slopes, and it is probable that in another century these valleys will have again become densely timbered and the high scarp of their upper edges will have become gently rounded. Many of the pines have already reached the height of from 40 to 50 feet.

Dampness of Walls and the Preservation of Microbes.

It is a matter of general interest to know how long disease germs will remain in a contagious condition in a house when the latter has not been thoroughly disinfected.

Some special investigations have been made on this point by M. Vito lo Bosco, a hygienist of Palermo, Italy, says L'Illustration. The investigations were made of the walls of dwellings exclusively, as the floors are generally easily cleaned and disinfected.

The life of the pathogenic germs was found to vary greatly with the different materials of which the walls were constructed, and especially according to their degree of dampness or dryness.

As a general rule, walls covered with stucco or varnish were found least favorable for prolonging the life of the microbes, and walls which are normally dry possess to a considerable degree the power of self-cleansing. The typhoid bacillus, the cholera germ, the diplococcus of pneumonia, when placed on such walls, die after twenty-four hours at the maximum, and the diphtheria bacillus survives only seven days. The tuberculosis microbe only can remain alive for two or three months. On well-dried size, however, it survives even four or five months.

Damp walls, on the contrary, cause the vitality of bacilli to increase, and this to such a degree that the period of life of some under these conditions has not yet been determined. The microbe of typhoid fever, for instance, remains alive three days, that of diphtheria a month, and that of pneumonia from fifteen days to three weeks.

The knowledge of these facts should bring about useful practical applications.

The dampness of dwelling houses appears doubly dangerous, first, in itself, and second, because of the long life which it gives to the elements of contagion and infection.

Contrary to the traditions of the elegance of dwellings, which cause the walls to be covered with tapestry or paper in imitation of it, scientific experience would advise the employment of stucco or good varnish, which are best from a bactericidal point of view, both because they are easily washed and because they possess the property of cleansing themselves promptly and spontaneously of pathogenic germs which become lodged on them.

The August Building Edition.

The August issue of our Building Edition is a beautiful number of this unique periodical. It is filled with exquisite half tone engravings executed in the highest style of the art. The colored cover shows a model cottage at Larchmont, N. Y., and is a handsome specimen of colored work. The New Jerusalem Church at San Francisco, Cal., is the subject of several engravings. It is one of the most picturesque churches in the country. The houses which are reproduced in this number are most interesting examples of suburban dwellings. They are freely illustrated by general views, floor plans and interiors. There are several pages of good reading matter. It is the aim of the publishers to constantly increase the value of this periodical, and those who have not seen copies of this edition in some time should purchase a copy of the August number.

The Current Supplement.

The current SUPPLEMENT, No. 1232, has a number of articles of great interest. "Life of Naval Cadets and Apprentices on the German Schoolships" is a profusely illustrated article. "Bullet Wounds in Modern Warfare" describes the wounds produced by the new bullets from the surgeon's point of view. "Elevators" is the first installment of an illustrated paper on the subject by Charles R. Pratt. A full page engraving is given of "Ships Building for the British Navy." This beautiful illustration gives a most impressive idea of English sea power. "Reduction of Sulphur Ore in Sicily" describes a technical consular report of considerable importance. "Pottery as an Historical Document" is an address by Sir George Birdwood. "Methods of Determining the Frequency of Alternating Currents" is a valuable article on electrical testing.

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RECENTLY PATENTED INVENTIONS.

Railway-Appliances.

CAR COUPLING.—THOMAS HENRY SMITH, Bowie, Tex. The invention provides an automatic locking arrangement for a car coupling. The coupling consists of a stationary jaw and a swinging jaw vertically pivoted upon it. A horizontal shaft passes through the stationary jaw and the rearwardly projecting arm of the movable jaw, which is slotted to receive a couple of beveled keys on the shaft. Two other keys are fitted to the shaft between this arm and the stationary jaw, and these serve to lock the coupling when it is closed. The shaft on which they are placed has a weighted arm at each end which holds it in the proper position. By giving it a quarter turn, both pairs of keys are so placed as to slide into openings in the stationary jaw and movable arm when the coupling is opened. When it is closed, they assume their former position automatically.

Steam Generating Apparatus.

BOILER FURNACE.—ANDRÉ P. RITZOS, Galata, Turkey. The furnace has two chambers, one for the combustion of the fuel and a larger one containing the heating coils. There are three coils arranged transversely across the chamber. The front one is the highest and has the interstices between the pipes filled so as to make a complete partition. This causes the gases of combustion to rise and pass over the coil, when they descend between the other two coils and pass out at the bottom of the chamber.

BOILER FEEDING APPARATUS.—JAMES SCOTT, Hakodadi, Japan. This invention consists of two water receivers, in which the steam pressure of the boiler acts alternately so as to force water from the receivers past check valves into the boiler. It is particularly adapted for use in boilers in which there is a strong back pressure on the steam and in which it would be difficult to feed water by the ordinary appliances.

Electrical Inventions.

CONDENSER.—PETER COOPER HEWITT, 11 Lexington Avenue, New York, N. Y. This condenser consists of a plate of glass having concentric rings of tinfoil arranged upon both sides. There is an open space between the ends of each ring, and the end of one ring is connected to the end of the next in such a way as to form a continuous spiral, and also so that the discharge will take place in opposite directions on the two sides. The magnetic effect is centralized by causing the discharge to follow the path in the coatings, and sufficient current is induced in a secondary to light a lamp.

TELEGRAPH SOUNDER.—JAMES SWINTON BAYNARD, care L. R. L. Pritchard, 115 Broadway, New York, N. Y. The improvement made by this inventor consists in a circular case of some resonating material in which the sounder is placed. The arm against which the armature lever rebounds may be brought in contact with the cover, thus producing very loud sounds, or it may be adjusted so that the lever makes a short stroke, and hence works very quietly. In order to increase the difference in sound on the attraction and release of the armature, the cores of the electro-magnets have hard-wood plugs fastened in their tops. The bottom of the case screws into the top part, and in its sides are holes which correspond with holes in the latter, by the partial or entire closing of which, the sounds are also muffled.

ELECTRIC DOOR OPENER.—ADOLPH F. T. WIECHERS, 9 Columbus Avenue, New York, N. Y. The chief features of this invention consist (1) of a novel push button to be placed in an apartment or flat for the purpose of unlatching the front door; (2) an automatic circuit maker fastened to the hammer of an electric bell. By turning the button to a certain position contact is made by a pin with some mercury or powdered carbon, which forms a connection through the button with the circuit closer on the bell hammer. When the button is pressed at the front door, the vibration of the bell hammer makes the circuit through the automatic door latch, and unlocks the door.

ELECTRIC SIGNAL.—WENDELL H. STILLWELL, Topeka, Kan. The object of this signal is to call the attention of an engineer to orders which he might overlook, at any point on the road where it is desirable. An electric bell is attached to the order board, and one wire from the bell passes under each clip. The clips are connected, and, consequently, if there are no papers under them, the current will be short-circuited, while, if there are papers, the bell will ring till disconnected by the engineer. The connection is made by a push lever with small wheel on the end, which rolls over a block beside the rail.

ARC LAMP.—EDWARD M. CASHION, Glens Falls, N. Y. The object of this invention is to provide a simple and adjustable means for permitting and regulating a continuous passage of air through the inner globe of an inclosed arc light. The inventor forms the top and bottom of the inner globe of two disks, the inner one of which fits loosely around the carbon, leaving an air passage, and the outer one fits snugly, so that the air must pass out between the disks. The distance of these apart is regulated by screws. A pan to catch the dust is fitted around the lower carbon just above the inner disk. The life of the carbons has been found to increase four or five times by the use of this device.

Miscellaneous Inventions.

HOG-TRAP.—JOHANN J. EHMEN, Chattan, Ill. This invention provides a trap for holding hogs in order to ring their nostrils. The trap when set has both its end doors open so that the hog will see what appears to be a clear passage-way and will readily enter. When he has entered the trap, he will step upon a tripping device which releases both doors so that they will close simultaneously.

BATTER MACHINE.—JOHN CALVIN ROBERTS, Bedford, Pa. The object of this invention is to provide a machine in which the ingredients for forming batter may be quickly and thoroughly reduced to the proper consistency and then stirred together and made ready for the oven. The machine contains a sugar crusher, a beater, and a sieve. To form batter, the proper amount of sugar is placed in a graduated hopper, and by simply turning a crank it is pulverized and falls to the bottom of the machine, where the beater is situated. This is then thrown into gear and eggs are beaten up with the sugar. The pulverizer is afterward replaced by a sieve, through which the other ingredients forming the batter are introduced.

BEATER AND SIFTER.—JOHN CALVIN ROBERTS, Bedford, Pa. This machine is the same as the preceding one, with the exception of the sugar pulverizer, which is omitted. It is used for sifting flour, etc., and mixing it with eggs and other ingredients, both operations being carried on simultaneously or separately as desired.

SELF-DRAINING CULINARY VESSEL.—HELEN J. CARDEN, Bakersfield, Cal. The vessel is an octagonal saucepan having small perforations in one half of its cover, which is permanently fastened to the sides, the other half being removable, in order to insert the vegetables. A lid covers the perforations in the cover while the vegetables are cooking, and is provided with a simple catch which holds it in place but allows of its being blown open if the pressure becomes too great. Since the vessel has a flat side, it can be laid down and allowed to drain without any special attention.

INDIAN CLUB.—SAMUEL A. TAYLOR, care M. J. Gleason, 142 Fulton Street, New York, N. Y. The invention covers two forms of club, one made of rubber and inflated and the other having a skeleton wire frame covered with leather or other suitable material. In both kinds a spiral spring is placed in the handle of the club, so that if it is dropped on its end it will rebound. Many other new effects can be produced with this club, while it cannot damage furniture in the least.

LIGHTING ATTACHMENT FOR ALARM CLOCKS.—CULLEN A. ROBERTSON, The Wonderful Clock Company, Milledgeville, Ga. The attachment consists of a spring-actuated match-holder arranged to ignite a match by rubbing it over some sand-paper, the match lighting a fuse suspended over it, which in turn lights a candle or fire. The match-holder is released by a tripping lever connected with the alarm winder of the clock.

SHOW CASE.—ERNEST FADUM, Assignor of one-half to Reinle Brothers & Salmon, Baltimore, Md. The novelty of this case lies in the fact that each and every glass can be removed at will without injuring it in any manner. The frame is made of metal channel plates and the glass top is held in place by the side pieces, which also support the slanting front.

FILTERING TANK FOR USE ON STREAMS.—EDWARD MAGINN, Allegheny, Pa. The tank is built along the river bank, which forms one side of it, and its ends make obtuse angles with the bank. The sides are formed preferably of sheet steel, held in place by steel piles driven on both sides. A low exterior wall surrounds the tank, and the inclosure thus formed is filled with sand, as is also the bottom of the tank. The water percolates through the sand and thus is purified, after which it is drawn off from the tank through a pipe line.

INDEX.—BAILEY DUKE LÉ GRAS, Assignor to the Brandon Printing Company, Nashville, Tenn. The index consists of a large sheet having an index tab running the length of the right hand side. Slits opposite each other and spaced apart are arranged down the sides of the tab, and into these are placed properly ruled slips of paper on which the balances may be posted, the name of the party or firm owing the balance being placed in the space above. The index tabs project beyond the leaf and may be multiplied to any number required. The book adapts itself to the use of bankers, merchants, manufacturers, and to all other businesses in which a general self-indexing account book is required.

MUFF-LINING.—MARGARET MAGUIRE, Windsor, England. The object of this invention is to provide a lining for ladies' muffs which can be readily inserted or removed, and which will remain fastened in the muff without sewing. This is accomplished by making a collapsible cylinder of silk with flanges on each end, which are held in shape by means of a wire. The cylinder can be gathered up in the middle or let out to fit any sized muff.

MAIL-POUCH CLOSURE.—WALTER A. PIATT, Pine Ridge, S. D. The pouch has a top or cover made of a strip of leather doubled over with a metal plate in the fold. The top is held in place over the open end of the bag by means of riveted staples or brackets on both sides of the neck of the pouch. A small space is left between the top and the mouth of the bag, through which to extract the mail matter, and the bag is closed by a metal bar H-shaped in cross section, the cross arm of the H going between the top and neck of the bag, and the side uprights passing along the mouth under the U-shaped brackets. The end of the closing bar is locked to the edge of the bag by a hasp and padlock.

DUMPING SCOW.—FRANKLIN P. EASTMAN, 265 Broadway, New York, N. Y. The center of the scow has a peak-shaped cross section running longitudinally the whole length. Hinged sides are fastened to it and are so arranged that they can all be unlocked and lowered simultaneously, thus ridding the scow of its load.

WAGON-STANDARD.—JASPER N. SMITH, Tiverton, Ohio. The invention provides an easily detachable wagon standard to be placed on a bolster or other support. To the end of the bolster is fastened a U-shaped strap, on opposite sides of which are single holes penetrating through into the wood of the bolster. A flat steel spring with a pin near one end is fastened to the standard, and the pin goes into the hole provided for it, thus locking the standard effectually to the bolster.

PEW ROPE AND LOCK.—WILLIAM H. CLARK and LLEWELLYN J. WATTSON, San Francisco, Cal. The object of this invention is to provide a lock that may be made of uniform size with the rope with which it is to be applied, and wherein the body and keeper of the lock will be connected by a chain concealed within the rope and preventing it from stretching. The lock is of a simple yet durable construction and of such a form that the keeper and lock may be brought automatically to a locked position, but cannot be separated without using a key.

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(7707) H. K. W. asks: Will a platinum wire heated by an electric current ignite the compressed charge in a gas engine? A. Platinum wire, heated by an electric current, would act too slowly to be used for igniting the charge of a gas engine. A spark is instantaneous. A wire requires time both to heat enough to set fire to the gas and to cool enough to allow the next charge to enter the cylinder without igniting it.

(7708) H. B. writes: I have a thermometer hanging in a room (an exceedingly accurate one). It registers 82° say; now I start a small electric motor and hang the thermometer directly in front of it, what will be the effect on the thermometer? A. The proper reply to this inquiry is, try it and see. It is so easy of practical solution. If the thermometer has no moisture on the bulb, it will not be affected by the current of air from the motor. If the bulb has moisture on it, the reading will be lowered since the heat necessary to evaporate this moisture will most easily be obtained from the mercury of the thermometer, thus cooling it. A dry thermometer registers the temperature of the place where it is. A wet bulb thermometer registers the temperature produced by evaporation of water, usually lower than that of the air where it is. This is sometimes called the "sensible temperature." A current of air from a fan cools us by removing the air which is at the moment in contact with our skin, and which is saturated to a degree with moisture from the skin, and replacing this air with other air which contains less moisture. This dry air takes moisture from the skin and the evaporation of this moisture makes us cool.

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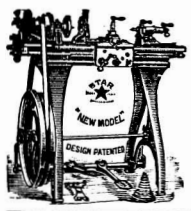

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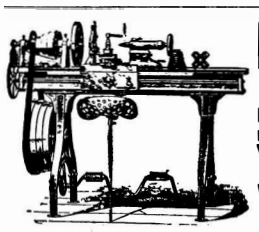

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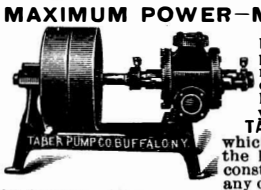

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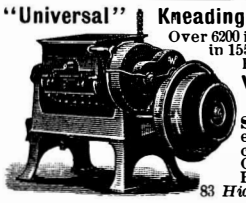

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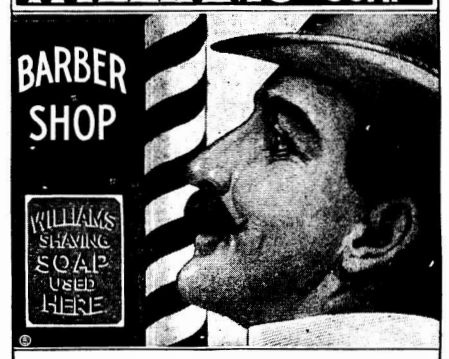

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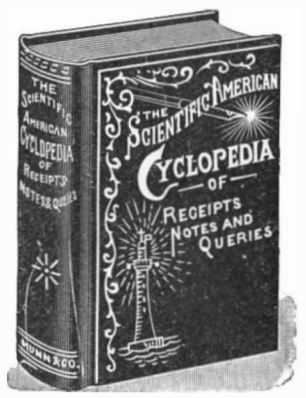

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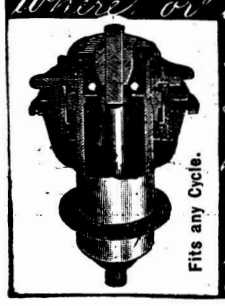

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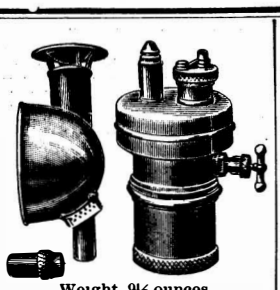

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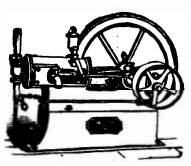

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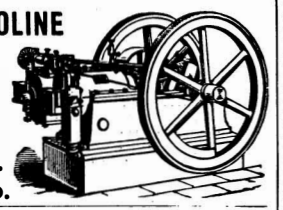

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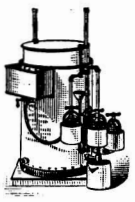

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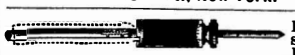

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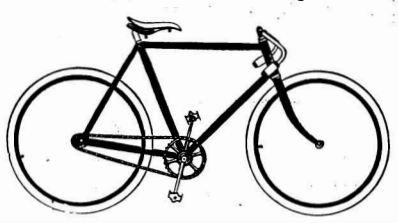

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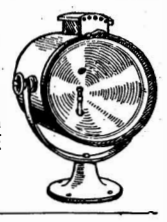

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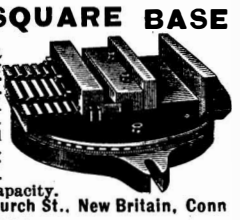

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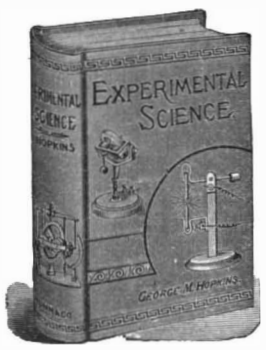

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